

Accessible Transportation Technologies Research Initiative (ATTRI) Institutional and Policy Issues Assessment

Task 6: Summary Report

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16. Abstract This report summarizes the research and findings of the Accessible Transportation Technologies Research Initiative (ATTRI) Institutional and Policy Assessment. The objective of this project is to identify and analyze the policy, institutional, and legal issues that are hindering development and deployment of advanced technologies with potentials to improve mobility for people with disabilities. The major policy, institutional, and legal issues identified include lack of awareness of disability needs among policy makers and technology developers, relatively weak research and development incentives due to the perception of lack of economic feasibility in the market of persons with disabilities, under utilized potential of Transportation Network Companies (TNCs) in providing paratransit services, inconsistent standards/regulations/laws across regions, and technology developers' concerns of liabilities and risks. A list of eight potential actions was proposed to address those issues. The proposed actions were evaluated and prioritized based on their travel and economic impacts and feasibility.					
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Executive Summary

This report summarizes the research and findings of the Accessible Transportation Technologies Research Initiative (ATTRI) Institutional and Policy Assessment. The objective of this project is to identify and analyze the policy, institutional, and legal issues that are hindering development and deployment of advanced technologies with potential to improve mobility for people with disabilities. A list of potential actions is proposed to address the issues and preliminary evaluation was performed on the proposed actions regarding their travel and economic impacts and feasibility for implementation.

Chapter 2: Identification of ATTRI-Related Institutional and Policy Issues

Following an introduction, Chapter Chapter 2 of the report sets out the institutional, policy, and legal issues found in the research that affect the deployment and development of the target technologies. As the report identifies and analyzes institutional, policy, and legal issues, it also notes policies, institutions, and law that effectively promote and improve mobility for persons with disabilities, including federal funding programs, federal, state, and local regulations, and institutional arrangements among public and private enterprises.

Policy Issues

Awareness and Product Development

While there are many elements which influence how and when a technology or product is developed and distributed, awareness of user needs is the starting point of this process which we found to be widely recognized as an issue. Economically speaking, awareness of a need will eventually yield the deployment of some product or idea to address that need if it is economically viable or socially wanted, provided the market is perceived to be sufficient to offer a return on the cost of the development and deployment process, including starting up and operations. The wider the awareness and the greater the need, the more likely or more urgently such needs will be met by properly designed product. Market gaps can form when demand (while real and immediate for the individuals affected) is perceived to be too small to warrant the investment. Public and private industry policy may play a role in 1) evaluating and possibly correcting the perception of a limited market; 2) identifying ways to combine small market niches to make them more attractive; 3) providing subsidies to reduce the required investment, risk to serve the unmet demand.

The research in this area indicates that there are existing initiatives that attempt to meet the needs of people with disabilities, but that there remains a significant policy issue for understanding the user needs, meeting the awareness and product development needs of people with disabilities.

Besides the lack of awareness of users' needs among persons with disabilities, there is in general a lack of awareness of the overall impact of technology innovation for the disability community. The extent of impacts, from empowering individuals with disabilities to the economic and social benefits for their family,

healthcare providers, and the greater community, are often not fully understood among policy makers and technology developers.

Funding

Funding issues include funding for the direct utilization of accessible technologies by persons with disabilities, for the development and deployment of advanced accessible technologies, and for addressing the barriers to that development and deployment.

Funding sources for people with disabilities are fragmented. Persons with disabilities are sometimes not aware that certain funding sources exist, while other funds may be locked behind specific eligibility requirements or exist as tax incentives instead of direct funding assistance. The background research indicates that funding for accessible technologies is a policy issue that should be examined both in terms of scope, organization, and availability. Every individual who is unable to access possible ATTRI technologies due to insufficient funding will both decrease the cost effectiveness of any technology development and deployment effort, as well as lessen the overall impact of ATTRI technologies. Inability to access technology can be caused not only by a lack of financing but also by the user's inability to navigate and locate funding sources. A brief overview of existing funding sources and programs in Chapter 2.1.2 illustrates the fragmented nature of accessibility funding.

Research and Development Incentives

Although automated vehicles are not the focus of this study, they have the potential to greatly improve mobility for persons with disabilities. The technology has now entered the testing phase in many states in the US and in other countries. Even though theoretically a fully-automated vehicle turns a driver into a passenger and seem to be an ideal mobility solution for persons with disabilities, lack of accessibility in vehicle design, for example passenger-vehicle interaction interface, may greatly reduce the technology's appeal to persons with disabilities. Therefore it is essential that accessibility is considered early in the design process to promote accessible automated vehicles for the population with disabilities. The benefits of automated vehicles for persons with disabilities may also be limited if requirements, such as a special license or responsibilities of a traditionally licensed operator, are applied to automated vehicles. Meanwhile, affordability may be a major barrier for persons with disabilities if the technology remains a luxury option.

For a broad range of new technologies with potential to improve mobility for persons with disabilities, ensuring that more public entities and private companies enter the market may be an issue worth examining, as in general, greater economic involvement would improve both the service that consumers receive as well as reduce the eventual costs of such technologies as products become more mainstream rather than specialized. An interviewee noted that there are challenges in providing development initiatives because of a relatively small market and limited profit, however there are pockets of opportunity, citing the Smart Cities Challenge, Mobility on Demand Sandbox Program, as well as some discretionary programs in the FAST Act.¹ A number of development incentive policies also exist to encourage participation in the market. For example, Small Business Innovation Research (SBIR) grants are administered through the Small Business Administration, and are intended to support research and develop efforts by small businesses. Other development incentive policies and programs include the FHWA Exploratory Advanced Research Program, committed research funding for technology deployment through Broad Agency Announcements (BAAs) by the ATTRI Program with the Intelligent Transportation

¹ Based on results from stakeholder interviews.

System (ITS) Joint Program Office (JPO) and the Federal Transit Administration (FTA), and ATTRI's recent partnership with Department of Health and Human Services and National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR). More companies are deciding to enter the market for serving persons with disabilities. In part some of these efforts have begun because of a perception of an existing market among the general public that also serves individuals with disabilities. An example of this is the automated vehicle market. The ATTRI program, to be successful, must seek to not only identify but also deploy ATTRI technologies that not only address the needs of travelers with disabilities but travelers in general. Integrating accessibility needs into technology development early lowers the costs relative to later retrofits; however the biggest benefit is that new developments which have mass market appeal are the easiest way to encourage private companies to take the risk of developing those technologies with universal design and incorporating inclusive information and communication technologies (ICT) solutions. Ensuring that new technologies being deployed are useful not only for the population in general but also people with disabilities will help both the social acceptance and conversely the market reach of accessibility technologies.

Gaps in mobility remain for people with disabilities. More and greater incentives for technology developers would be conducive to filling the gaps with deployment of advanced technologies.

Institutional Issues

Transportation Network Companies (TNCs)

TNC's such as Uber and Lyft are defined by the Transportation Research Board's (TRB's) recent report on innovative mobility services² as services that provide reservations and tracking of vehicles, billing, and quality control in either concurrent (pooled rides) or sequential (private rides) modes. The TRB report suggests that as the largest operators in the TNC industry, Uber and Lyft are likely to play central roles in addressing issues of access for people with disabilities.

So far, TNCs' efforts to partner with transit operators in providing paratransit services have seen mixed results. Uber approached the City and County of San Francisco, for example, to take over the city's paratransit services for the older adults and those with disabilities. Because of unresolved insurance issues on how much liability TNC drivers are protected from, however, those talks did not culminate in an Uber/San Francisco agreement of that scope at that time. More recently in Boston, a one-year pilot program has started between TNCs (Uber and Lyft) and the Massachusetts Bay Transportation Authority (MBTA). The program will cost less for riders (\$2 at the beginning of their trip and the rest of fare above \$15) and could save the MBTA \$10 million annually.³ Uber has also created variations of its service in the outer boroughs of New York City and Los Angeles. Similarly, Lyft allows users to enable an "Access Mode." Both of these services dispatch vehicles that are specially outfitted to accommodate wheelchairs, typically at a cost that compares with that of limousine or UberBlack service.

TNC technology has encroached on the market of traditional taxi companies with unprecedented speed, threatening the market reach and economic viability of traditional taxi companies. This is a potential issue

² <http://onlinepubs.trb.org/onlinepubs/sr/sr319.pdf>, Between Public and Private Mobility,

³ <http://news.wqbh.org/2016/09/19/politics-government/mbta-partners-uber-and-lyft-paratransit-ride-pilot-program>

for the ATTRI program because TNC deployment also threatens existing arrangements that many transit providers have with taxi companies that call on the taxi companies to provide a certain level of access. These taxi access requirements generally do not apply to TNCs, and in some cases are statutory requirements addressed specifically to taxi companies. Replacing lost accessible taxi service is a huge concern for local jurisdictions⁴, and should be an immediate concern for the ATTRI program. However, this is also an opportunity to implement innovative institutional arrangements that can fulfill accessibility needs while remaining flexible in the face of shifts in the market providers. Finally, TNC companies rely on technologies that are a focal point of the ATTRI program, touching on wayfinding, local distributed networking, and digital app technology. With the increasing ubiquity of smartphones and staying online, this will pose a policy challenge as public agencies seem to form new relationships for providing accessible transit. As noted by Neil Pedersen of the TRB, the appropriate jurisdictional level for regulating TNCs is unsettled; their networks are standard and international.

Voluntary Standards

The background research has identified that a potential institutional issue is the lack of a broad private industry set of standards which meets the needs of consumers while remaining above and beyond the basic technical requirements of legal regulations. Several bodies are in the process of attempting to create such standards, but their work is not widely accepted within the industry as the “de facto” standard to adhere to. Addressing this issue may encourage future development and deployment of accessible technologies for transportation as there is a broad base of interoperable and non-proprietary technologies to support new products. A lack of a consistent standards regime will adversely impact the ATTRI program because differing technologies will have differing interaction requirements.

One approach to incentivize adoption of accessibility standards is through a certification program with wide industry and consumer recognition. The program should provide a system of certification that verifies and/or rates a product’s or service’s accessibility features based on established standards, e.g. ADA standards. A program like this, coupled with nation and industry wide recognition, would effectively enhance awareness of disability needs among product designers and service providers. It would also help consumers with disabilities to make informed selection of products and services.

Legal Issues

Inconsistent Laws

There are significant legal issues arising from the number of different jurisdictions which are involved in regulating accessible technologies. These extend across local, state, and national and international entities, and within each government as well (for example, a state Department of Motor Vehicle versus a state Department of Transportation). Disharmonious legal regimes have already emerged across these jurisdictions that will require manufacturers to meet different requirements in different regions. This type of patchwork legal framework has the potential to impede deployment. In part because of the developmental nature of accessible technologies, new technology and techniques offer benefits to persons with disabilities while simultaneously presenting challenges to regulators and consumers alike.

These legal issues are salient with regard to automated vehicles because of the pace with which private developers have been rushing to implement automated vehicles. Although automated vehicles are not

⁴Based on results from stakeholder interviews.

targeted only to accessible technologies for persons with disabilities, their relative utility for persons with visual or mobility disabilities is such that these legal questions may have a disproportionate impact on travelers with disabilities.

International Conventions, Treaties, and Practice

As a matter of pragmatic institutional policy, implementing a broadly acceptable standards regime would ease the development and interplay between technologies developed by different organizations, promoting widespread adoption and use of new products as consumers are more easily able to access and evaluate new products without investing significant amounts of time or money into proprietary tools. Economically, ensuring that standards used throughout the world are not too dissimilar will allow designers to comply with the requirements of different jurisdictions with minimal changes to their products, ideally, to create a product following universal design principles which need not be altered for use between different jurisdictions at all. Many of these regulations cover accessibility in general, including infrastructure, which intersects broadly with the ability of persons with disabilities to access transportation. Socialization of technologies and standards internationally will help promote collaboration and coordination among countries and regions, especially those with limited involvement with the U.S. Chapter 2.3.2 provides a detailed summary of international conventions, treaties, and practices regarding accessibility standards.

Domestic Regulations, US Laws, and Statutes

The most notable domestic regulations within the US have been primarily based on federal authority, mandating requirements for meeting the accessibility needs of people with disabilities in new constructions and renovations of existing facilities, and also provide some funding with associated compliance requirements. Chapter 2.3.3 provides in-depth discussions of the most prominent U.S. laws, regulations, and guidelines related to accessibility in transportation, which include:

- The ADA Standards for Accessible Design
- The Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way issued by the US Access Board
- Chapter 504 of the Rehabilitation Act that prohibits discrimination against individuals with disabilities under any program or activity receiving federal financial assistance
- The Architectural Barriers Act that requires certain facilities financed with federal funding to be accessible to individuals with disabilities,
- The Assistive Technology Act of 1998 that increases access to, availability of, and funding for assistive technology through state and national efforts.
- The 21st Century Communications and Video Accessibility Act (CVAA), signed into law on October 8, 2010 to update federal communications law to increase the access of persons with disabilities to modern communications

Privacy

Privacy topics apply broadly when speaking of the development and deployment of technological solutions for persons with disabilities. However, as noted in an interview with the US Access Board, the information of individuals with disabilities is not in and of itself of a type which would merit extraordinary protections. Rather, on a systemic level, it is merely one more piece of information which should be protected with the same vigor and attentiveness as any other piece of personally identifying information.

Chapter 2.3.4 explains the Health Insurance Portability and Accountability Act (HIPAA) and Federal Privacy Act of 1974 and discusses their implications for ATTRI technologies, including privacy concerns of connected and autonomous vehicles, applications, and wearable technology. Chapter 3 provides a more comprehensive discussion of privacy issues in relation to technologies for persons with disabilities.

Chapter 3: Personally Identifiable Information (PII) Privacy and Governance Issues

The study expanded on the privacy issues and concepts introduced in Chapter Chapter 2, and conducted a deeper analysis of the privacy considerations ATTRI should apply to the program. The research shows that privacy can be a balancing act between using and protecting information, but making sure that information is collected, used, and shared securely is the key to ensuring that the benefits of information use do not compromise privacy rights. Accessible transportation technology stakeholders can ensure that these protections are built into systems by considering the Fair Information Practice Principles (FIPPs) from day one of the planning process. These accessible transportation technologies are constantly changing and advancing and, at the end of the day, ATTRI stakeholders will only use technologies that they feel they can trust, so ensuring that information is protected is both best for the public and for the institution designing and implementing transportation technologies. Accessible transportation technology developers and public and private accessible transportation service providers can also consider privacy solutions available on the market, for example, Microsoft Trust Center⁵. Technology developers and service providers like transit agencies can rely on those privacy solutions to protect their users' PII and focus on their products and services.

For the most part, ATTRI may not be actively engaged in ensuring that privacy protections are input into and upheld by accessible transportation technologies. However, ATTRI will need to identify where there are gaps in privacy and data protection and step in as participants to ensure that stakeholders' rights are upheld.

Chapter 3 provides an overview of the research finding regarding ATTRI-related privacy issues and a list of high-level recommendations for ATTRI. Appendix C. Personal Identifiable Information (PII) Privacy and Governance Issues provides a more in-depth summary of the research on privacy issues.

Chapter 4: Identification and Evaluation of Potential Actions

The fourth section of the Report identifies and sets priorities for eight potential institutional, policy, or regulatory actions that would facilitate the development and deployment of advanced transportation technologies for persons with disabilities.

Proposed Potential Actions

From a wide range of potential ATTRI actions, a preliminary list of twenty potential actions was proposed initially. A workshop with USDOT staff and the research team members in September 2016 screened the

⁵ <https://www.microsoft.com/en-us/trustcenter/about/trust-center-overview>, accessed February 14, 2017.

preliminary list and selected eight actions with the most potential to address the policy, institutional, and legal issues identified. The eight potential actions are:

Action #1: Enhance Awareness of Disabilities Needs

The needs of people with disabilities are often neglected in product design and service delivery. The failure to address these needs is partly due to lack of awareness of disability needs. ATTRI has already made efforts in promoting the needs of persons with disabilities. In May 2016, ATTRI published “User Needs Assessment: Stakeholder Engagement Report”⁶ that documents the travel needs of people with disabilities. To promote the findings documented in this report and further enhance awareness, ATTRI should evaluate the most cost effective ways to serve its mission by enhancing awareness of inclusive and universal design, and of otherwise raising awareness in the transportation technology stream of the needs of users with disabilities. ATTRI could undertake a program of awareness campaigns. Another possible approach to enhance awareness of disability needs is to facilitate a certification program for product and service accessibility. The program should provide a system of certification that verifies and/or rates a product’s or service’s accessibility features based on established standards, e.g. ADA standards. A program like this, coupled with nation and industry wide recognition, would effectively enhance awareness of disability needs among product designers and service providers. It also would help consumers with disabilities to make informed selection of products and services. Advanced analyses are needed to determine what entity is most suitable for owning and developing the program, how the certification should be designed, and what role ATTRI should play in developing and promoting the program.

Action #2: Provide Funding for Enabling Technology Development & Deployment

Deployment of new technologies may require upgrading or installing new infrastructure, facilities or equipment in the public domain for the built and pedestrian environments, for example, sensors in public right-of-way and transit stations for short range communication with wearable devices, or lane marking for autonomous vehicles. In some cases, the required upgrade or installation can be such a huge investment that is not financially feasible for private enterprises partners to take on. However, the economic and social benefits of deploying such technologies may well justify the investment. Providing public funding to upgrade existing infrastructure and install new infrastructure for enabling technology deployment can fill the gap in the existing capacity to do so. ATTRI could identify sources of potential funding from existing programs, coordinate with other agencies that would benefit from the investment to secure funds from those sources, and advocate for new funding program to meet the needs of technology deployment.

Action #3: Provide Funding for Pilot Studies

Providing funding for pilot studies is another way to assist market deployment of technologies. Its primary impact would be the deployment of any specific technologies which reached commercialization. The analysis and selection of such technologies was not the subject of this research. However, a secondary impact of this action could be in overcoming institutional, policy and legal barriers such as those listed above, and thereby showing the way to reduce those barriers to other efforts. This action could target the readily available technologies, such as in-station Bluetooth-based navigation systems and augmented reality wayfinding, transit and wayfinding apps with static and real-time transit data, information and communication technologies (ICT) to aid in paratransit use, and first- and last-mile mobility solutions. Pilot studies will determine the economic feasibility of deploying such technologies and/or products for persons

⁶ Accessible Transportation Technologies Research Initiative (ATTRI), 2016, *User Needs Assessment: Stakeholder Engagement Report*, May. http://www.its.dot.gov/research_archives/attri/pdf/REV_508_ATTRI%20Final%20Report.pdf

with disabilities and explore business models, market potential, and marketing strategy for technology developers who may otherwise choose not to enter the market due to possibly false perception of small market potential and lack of economic feasibility.

Action #4: Provide User Subsidies

Lack of access to assistive devices such as smartphones is a major barrier for people with disabilities to benefit from technologies, like wayfinding applications. Providing user subsidies would encourage more people with disabilities to access wearable devices. To ensure the subsidy is used to purchase wearable devices, ATTRI could consider in-kind subsidies for people with disabilities, i.e. providing assistive devices instead of monetary subsidies for people with disabilities. Similarly, user subsidies for other products and services, such as TNCs' services, would encourage market deployment of related technologies as well. ATTRI should also consider training subsidy recipients to use the technologies.

ATTRI could help people with disabilities seek subsidies from existing sources. For example, the federal program, LifeLine, provides smartphones and data plans at a discounted cost to low-income residents who meet income eligibility requirements. ATTRI could expand benefits from existing subsidy sources to people with disabilities by gathering support to secure funding from those sources.

Action #5: Provide Guidance on Liability and Indemnification Issues

The potential risks of liabilities associated with technology deployment for people with disabilities can be perceived as significant and can be inhibiting. People with disabilities may be perceived as more vulnerable to hazards on the road. The variety of disabilities and the mobility needs makes it more difficult to contain the potential risks of technologies targeting people with disabilities. The burdens that general consumer protection standards put on technology developers may be too restrictive for some technology developers and may limit deployment. It is proposed that ATTRI provides them guidance on liability and indemnification issues. The guidance can specifically address risks and liabilities among potential users with disabilities. Nonetheless, the guidance should not be regarded as substitution for professional legal advice. The guidance should advise technology developers to hire specialized attorneys as needed to provide tailored solutions.

Action #6: Potential Limitation of Liabilities for New Business Ventures

For new business ventures, which are most vulnerable to liability claims, limiting their exposure to liabilities would help these enterprises sustain and grow in the very initial phase of establishment. Limiting liabilities for start-ups which meet criteria defined according to the ATTRI mission requires legislative actions from the Congress and/or state legislatures. ATTRI can play an advocacy role in advancing the awareness among legislators of such needs and broader benefits to people with disabilities.

Action #7: Potential Limitation on Utilization of ATTRI Related Development Efforts in Tort Litigation

One last step that could reduce perceived risks in development and deployment of technology would be to prohibit or limit the use of accessible design, and accessible deployment efforts in tort (including negligence) litigation against technology developers and technology providers. This could be accomplished through some combination of federal and state legislation. While a technology firm would remain liable for negligence, that negligence would have to be established without using as evidence the firm's specific efforts to make its technology accessible to persons with disabilities. Many questions remain as to precisely how and on what terms such a limitation could be enacted, but there are analogous protections, e.g. for efforts to make a product or service safe to use, which could provide

guidance. As the liability and indemnification guidance should advise, technology developers should seek professional legal advice as needed from specialized attorneys even with enacted legislation to limit use of ATTRI related development efforts in tort litigation.

Action #8: Enforce Existing Regulations to Eliminate Barriers in Public Right-of-Way

Barriers in public right-of-way, for example broken pedestrian sidewalks, missing curb cuts, textured sidewalk surface, for people with low vision, hinder people's ability to access almost all modes of transportation. They also reduce the utility of many advanced technologies that could have overcome some mobility challenges for people with disabilities. For example, wayfinding applications for pedestrians with disabilities would be less useful where the pedestrian infrastructure is poorly designed and maintained. Public right-of-way is generally a responsibility of state and local governments. Federal, state, and local regulations set minimum accessibility requirements for people with disabilities. A potential action for ATTRI is to emphasize the existing regulations to the public right-of-way owner governments and to raise awareness of the benefits of such regulations by deploying advanced technologies among the enforcement agencies. ATTRI could achieve that by promoting the free ADA training offered by the FHWA Resource Center for federal, state, local government employees and private individuals.

When considering the proposed actions, ATTRI and other potential action owners should be aware that a January 30, 2017 executive order requires executive departments and agencies to manage regulatory activity in a specific manner. The new requirement may increase the difficulty of a proposed action if it involves issuing new regulations. Implementation of Actions #4, #6, #7, and #8 may be affected by this executive order.

Criteria for Actions Evaluation

A set of criteria for assessing impacts of potential action items was established. Three major areas of criteria are proposed:

- Travel impact in terms of number of additional trips as a result of a proposed action, including impact on people with disabilities and impact on all travelers,
- Business and economic impact, in monetized value, and
- Feasibility of proposed actions, for example, timing, prerequisite resources and actions, and dependency on other stakeholders. The proposed actions are ranked by their feasibility.

There is some unavoidable overlap between the first two major areas of criteria in that both impact important secondary outcomes such as healthcare and employment. In the case of travel impact, most additional trips will be made for a work, consumption (service or retail), or healthcare purpose rather than for travel itself. Thus, an increase in trip making among the three ATTRI stakeholder groups reflects an increase in these important activities. As employment and healthcare outcomes improve, there are important business and economic impacts that include less reliance on social benefits, an expansion of the labor force, and greater worker productivity.

For each of the criteria, Chapter 4.3 describes the assessment methodology, provides relevant findings from prior research, summarizes data sources, and presents the assessment for each of the eight action items. Assessment based on these criteria is summarized for all proposed actions and the actions have been prioritized based on a comprehensive review of the assessment results. Several of the recommended action items are broad in scope; the next steps will involve further refinement, evaluation

of alternatives, and reformulation of the steps forward. Further, these actions are evaluated with respect to policy, legal, and institutional issues; ATTRI addresses technology opportunities outside the realm of policy, legal and instructional issues, and so these actions might contribute to but do not circumscribe an ATTRI strategic plan. A high level summary of the evaluation and prioritization results can be found in Table 1 at the end of the Executive Summary.

Actions Evaluation and Prioritization

The proposed actions were evaluated and prioritized according to the criteria described above.

Travel Impact

Travel impacts were evaluated for people with disabilities, as well as for all travelers in the United States. For people with disabilities, a literature review concludes that major mobility constraints for persons with disabilities include (1) difficulty of walking due to poorly designed and/or maintained pedestrian environment, (2) difficulty to use a personal vehicle, (3) difficulty to use public transit and paratransit, and (4) unaffordability of available transportation options. The actions items that would facilitate the removal or reduction of mobility barriers in the above areas were estimated to have higher positive impacts on trip rates. Details of the evaluation results of travel impacts of potential actions for people with disabilities are summarized in Table 5 in Chapter 4.3.1.

ATTRI technologies may benefit not only the ATTRI stakeholder groups, but also have spillover effects on other travelers. We assessed the possible impacts on people without a disability, and then combined the impacts for all travelers. Some of the potential actions, by its nature, will generate very little benefit people without a disability. Action #1, enhancing awareness of disability needs, and Action #4, providing user subsidies, are narrowly targeted at the ATTRI stakeholder groups, so they would not have any substantial impacts on those without a disability. Most other actions, however, would benefit all travelers through helping private enterprises develop and deploy travel related technologies in general. The travel impacts of potential actions for all travelers are summarized in Table 6 in Chapter 4.3.1.

Travel impacts were also separately estimated for older adults and veterans with disabilities using the same methodology. Details of estimation and results can be found in Appendix B.

Economic Impact

The economic impact assessment was built on the travel impact assessment. The annual gross economic benefits of each action were estimated by multiplying the number of additional trips per year estimated in travel impact assessment and the economic value of each trip. The calculated benefits do not take into consideration the cost of implementing each action. The economic value of each trip was estimated based on guidance from the Federal Emergency Management Agency (FEMA)⁷, which totals a gross benefit of approximately \$166 in 2016 dollar for each additional trip. The gross economic benefit per trip considers the growth and wealth creation that benefits everyone, not only the traveler (health providers, retail stores, transportation companies, etc.). Table 7 summarizes the estimated economic benefits of the proposed actions for persons with disabilities. For action items ranking high, the estimated gross economic benefit is approximately \$230 billion (i.e. 0.31% of GDP), while for each medium ranking action

⁷ Federal Transit Administration, 2014, *How to Use the FTA HMCE Tool*. http://www.fta.dot.gov/documents/FTA-User_Guide-final.pdf

item the benefits could be between \$92 billion and \$138 billion (i.e. 0.13%-0.19% of GDP). Table 8 provides a summary of the actions' estimated economic benefits for all travelers.

Feasibility

Besides benefits, the priority of a potential action should also depend on its feasibility. Feasibility of the potential actions was assessed based on the following criteria:

- Timing of action
- Dependency on owner of the action
- Prerequisite issues
- Alignment with US Department of Transportation (DOT) and ATTRI priorities
- Alignment with the interests of United States Department of Transportation (USDOT) Constituencies

Timing of Action

The potential actions were evaluated based on the timing of when they could be implemented. Actions that can be taken quickly will receive higher priority, but actions that could have the desired impact even if delayed will receive lower priority.

Dependency on Owner of the Action

The potential actions involve various entities in decision making and implementation. Some of the actions can be implemented by ATTRI alone or within or outside USDOT. While others depend on parties beyond USDOT's influence, e.g. federal, state, local legislative bodies, executive offices and agencies, or private sector. Actions that can be implemented by ATTRI or USDOT alone will receive higher priority, while the more an action relies on other parties the lower its ranking.

Prerequisite Issues

Implementation of some potential actions is dependent on issues to be resolved beforehand, while other actions do not have such prerequisites. Those without prerequisites will be rated higher, and those with many and complex prerequisites will be rated lower.

Alignment with USDOT and ATTRI Priorities

The potential actions are evaluated by their levels of alignment with USDOT's and ATTRI's priorities, including the strategic goals of the USDOT, according to its 2014-2018 Strategic Plan, and the strategic themes of the Intelligent Transportation Systems Joint Program Office, as laid out in its 2015-2019 Strategic Plan. The potential actions all directly address one or more of these areas. Therefore all actions are rated "high" for this criterion.

Alignment with the Interests of USDOT Constituencies

The potential actions are also evaluated based on their alignment with the interests of USDOT constituencies, e.g. technology users, private technology developers, state and local governments, and other stakeholders. Alignment with the interests of the constituencies would allow ATTRI to draw upon their political support, whereas misalignment would induce resistance.

Overall Feasibility Assessment

Based on the evaluation of each feasibility criterion, an overall feasibility ranking is assigned to each potential action, which is summarized in Table 9 in Chapter 4.3.3.

Prioritization of Potential Actions

An overall priority ranking was calculated for each action, which was intended to comprehensively reflect the assessment results based on the three proposed criteria and help ATTRI prioritize the potential actions for implementation. Table 1 summarizes the impact assessment results of each proposed criterion, as well as the overall prioritization of potential actions.

Chapter 5: Next Steps

For next steps, this research suggests ATTRI should carry out fuller exploration and develop more refined action programs for the proposed action areas, starting with the ones with the highest priorities.

As first steps, ATTRI could evaluate alternative campaigns to promote disability needs and universal design for both physical products and ICTs (Action #1). The campaigns could target private technology developers and policy makers, and proactively involve the disability community in three-way dialogues with technology developers and policy makers. Possibly as part of these educational campaigns, or through alternatives, ATTRI could promulgate existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation for policy makers from state and local governments (Action #8). As ATTRI carry out awareness enhancement campaigns, it could study the feasibility and possible models for establishing a certification program for product and service accessibility.

The proposed action to fund pilot studies and assist small market deployment (Action #3) is another one that ATTRI could implement quickly. In fact, during the course of this study, ATTRI issued solicitation of proposals to develop applications for accessible transportation. We recommend ATTRI continue such efforts and consider providing more market deployment assistance.

The other two potential actions to provide funding (Actions #2, to fund infrastructure required for ATTRI technology deployment and #4 to subsidize ATTRI technology users) require substantially more resources and efforts, as well as collaborations with other stakeholders. While ATTRI advocates for those funds, a relatively easy immediate step would be to document the existing sources of funding for technology developers and people with disabilities. A comprehensive funding resource guide could be published and periodically updated to help interested parties identify funds.

Meanwhile, ATTRI could plan for resources to develop guidance on liability and indemnification issues for technology developers (Action #5). This may require securing dedicated budget in the coming fiscal year for hiring consultants, publishing a guidebook, and promotion activities.

The actions to limit liability risks for technology developers (Actions #6 and 7) require legislative actions, which will require substantial review and planning if a decision is made to proceed with a legislative recommendation. ATTRI could contribute to the review phases by conducting or facilitating research in the two areas, i.e. potential limitation of liabilities for new business ventures and potential limitation on utilizing ATTRI related development in tort litigation.

Table 1. Summary of Potential Actions Evaluation and Prioritization

#	Action Group	Action Item	Assessment of Action Benefits		Feasibility Assessment (weight = 50%)	Overall Priority
			Travel Impact – All Travelers (weight = 25%)	Economic / Business Impact – Persons with Disabilities (weight = 25%)		
1	Awareness of Disability Needs	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	High	High	High	High
2	Funding	Provide funding for enabling technology development and deployment	High	Medium	Medium	Medium
3		Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: o navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding o transit and wayfinding apps, and share static and real-time transit data o ICT to aid in paratransit usage o first-mile and last-mile mobility solutions	Low	Low	High	Medium
4		Provide user subsidies, e.g. subsidized TNCs, smartphones, and other technologies underutilized due to affordability challenges	Medium	Medium	Medium	Medium
5	Technology Risks	Provide guidance on liability and indemnification issues	Medium	Medium	High	High
6		Potential limitation of liabilities for incubator enterprises	Medium	Medium	Low	Low
7		Potential limitation on utilization of ATTRI related development efforts in tort litigation	Medium	Medium	Low	Low

#	Action Group	Action Item	Assessment of Action Benefits		Feasibility Assessment (weight = 50%)	Overall Priority
			Travel Impact – All Travelers (weight = 25%)	Economic / Business Impact – Persons with Disabilities (weight = 25%)		
8	Change in Institutions and Policies	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	High	High	High	High

Source: AECOM.

Chapter 1. Introduction

This report summarizes the research and findings of the Accessible Transportation Technologies Research Initiative (ATTRI) Institutional and Policy Assessment. The ATTRI program is a joint U.S. Department of Transportation (USDOT) initiative between the Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), with support from the Intelligent Transportation Systems (ITS) Joint Program Office (JPO) and other Federal Partners. The intent of the ATTRI program is to conduct research to improve the mobility of travelers with disabilities through the use of ITS and other advanced technologies, and focuses on the needs of three primary groups: people with disabilities, older adults, and veterans with disabilities. The program aims to 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. Five technology areas have emerged as ATTRI focus areas: wayfinding and navigation, assistive technologies, automation and robotics, data integration, and enhanced human service transportation.⁸ The program plan for ATTRI covers three phases spanning over six years: Exploratory and User Needs Research Phase, Innovation, Prototype Development and Testing Phase, and Demonstration Phase.⁹

The objective of the institutional and policy assessment is to identify and analyze the policy, institutional, and legal barriers to development and deployment of advanced technologies for people with disabilities. A list of potential actions is proposed to address the barriers and preliminary evaluation was performed on the proposed actions regarding their travel and economic impacts and feasibility for implementation.

Chapter Chapter 2 provides an in-depth analysis of the policy, institutional, and legal barriers to technologies for people with disabilities. Among the identified barriers, most prominent are lack of awareness of disability needs among policy makers and technology developers, fragmentation of funding for mobility needs of people with disabilities, unregulated Transportation Network Companies (TNCs) and their underutilized potential in paratransit, lack of voluntary standards for technology development, inconsistent laws, the regulatory environment, including discussions about inconsistent laws, international legislation, and domestic legislation, as well as privacy concerns. Chapter Chapter 3 expands on the privacy issues and concepts introduced in Chapter Chapter 2, and provides a deeper analysis of the privacy considerations ATTRI should apply to the program. In Chapter Chapter 4 the research team identifies eight potential actions to address the barriers, primarily and most directly the issues of awareness, funding, and developer risks and liabilities. The proposed actions are evaluated based on three broad criteria: travel impact, economic impact, and implementation feasibility; based on the evaluation, the proposed actions are prioritized for implementation from ATTRI's perspective. In Chapter Chapter 5 the research team suggests a number of immediate and longer term next steps for ATTRI to consider that address the policy, institutional, and legal barriers. Appendix A presents four hypothetical scenarios developed by the research team to analyze policy, institutional, and legal issues faced by

⁸ <http://its.dot.gov/attri/index.htm>, accessed March 15, 2016

⁹ http://its.dot.gov/attri/attri_plan.htm, accessed March 15, 2016

technology developers and policy makers in some of the most typical situations of the everyday lives of persons with disabilities. Appendix B summarizes separate assessment of travel impacts on older adults and veterans with disabilities for the proposed actions. Appendix C provides a more in-depth summary of the policy and legal framework of privacy concerning ATTRI technologies.

Chapter 2. Identification of ATTRI-Related Institutional and Policy Issues

The research team conducted a literature review and interviews with policy makers, technology developers, and legal experts to identify policy, institutional, and legal issues that would hinder the development and deployment of technologies for people with disabilities.

Policy issues including the awareness reflected in policies toward transportation technology useable by persons with disabilities and relevant funding are outlined in the first section. Institutional issues (reflecting the actions and attitudes of organizations or institutions rather than individuals) including organizational awareness and integration of major relevant organizations are discussed in the second section. Finally, the legal issues are surveyed including the inconsistency of laws, international laws, common law, Federal regulatory issues and state and local issues.

2.1 Policy Issues

In developing and deploying technologies for people with disabilities, policy issues are important because they reflect the overarching desire and goals behind more pragmatic programs. Some policies are reflected through standards or regulations, which will be discussed later in the Regulatory Issues section, while others are manifested in a broader cross section of social initiatives. In creating an environment which is conducive for the widespread adoption of technologies for people with disabilities, identifying these issues becomes extremely important. Common issues for accessible technologies which have been noted in compiling this research report include awareness, product deployment, funding, and research and development. Product deployment is in part related to awareness, in that some technologies are difficult to deploy for widespread use for reasons of cost or economies of scale, while others have simply not been publicized to the degree necessary for widespread adoption. Funding is also noted to be an issue, as a number of programs and funding sources exist, but have different eligibility requirements or are divided between different organizations, some of whom are focused on serving a particular disability or need, rather than people with disabilities as a whole. Research and development also remains an issue due to being a nexus point which is affected by all three issues just discussed. A lack of awareness of the needs of persons with disabilities combined with a perceived and real lack of funding in turn influences the direction of public and private development efforts and the focus of product deployment. To date much of the focus of accessibility technology appears driven by market segments which are most profitable, instead of those which might affect the most people. Even the recent developments in automated vehicles and robotics are primarily driven by their market acceptance by the population at large, with secondary emphasis on integrating their use for persons with disabilities.

The National Council on Disability issued a report dated May 31, 2000 on Federal Policy Barriers to Assistive Technology¹⁰. In it, they note the existence of four primary policy barriers for assistive technologies. The four barriers are Awareness and Expertise, Accessible Product Development and Deployment, Comprehensive and Coordinated Funding, and Research, Development and Technology Transfer. Due to the age of this document, some progress has been made in addressing each barrier; however the general barriers remain relevant in considering the current institutional and policy barriers facing individuals with disabilities. Interviewed individuals have noted continuing problems with awareness and acceptance of individuals with disabilities and a lack of funding, which have slowed the development and deployment of widespread accessible technologies and policies to accommodate persons with disabilities. The largest barriers identified in the report was that users were unaware of what assistive technology was available, where to get it, how to pay for it, and user rights. This awareness barrier is a serious issue for ATTRI, because the development and deployment of technology is often part of a cyclical system. Greater awareness of a problem leads to development, and once developed a system must be deployed. However if deployment is unsuccessful, further development may be stymied for a perceived lack of users or impact.

2.1.1 Awareness and Product Development

The issue of awareness captures the policies that determine the extent to which institutions, including the design and development agencies and corporations, are aware of the needs of persons with disabilities. For example, a former state highway administrator interviewed regarding the opportunities for more accessible transportation observed that there had not been any significant awareness of the need for investment in accessible transportation at the beginning of his tenure.

There has been growing awareness of the issues facing persons with disabilities in the last few decades, but policies that do not adequately reflect awareness have often not been changed. While there are many elements which influence how and when a technology or product is developed and distributed, awareness of user needs is the starting point of this process which we found to be widely recognized as an issue. Economically speaking, awareness of a need will eventually yield the deployment of some product or idea to address that need if it is economically viable or socially wanted, provided the market is perceived to be sufficient to offer a return on the cost of the development and deployment process, including starting up and operations. The wider the awareness and the greater the need, the more likely or more urgently such needs will be met. Market gaps can form when demand (while real and immediate for the individuals affected) is perceived to be too small to warrant the investment to serve the limited demand. Public and private industry policy may play a role in 1) evaluating and possibly correcting the perception of a limited market; 2) identifying ways to combine small market niches to make them more attractive; 3) providing subsidies to reduce the required investment, risk to serve the unmet demand.

For example, if technology developers are fully aware of the distinguishing needs of persons with disabilities, then community navigators useful to persons with disabilities as well as pre-trip and en route traveler information systems will be developed in the course of maximizing the profit for related technologies.

¹⁰ http://www.ncd.gov/rawmedia_repository/c9e48e89_261b_4dda_bc74_203d5915519f.pdf, accessed January 1, 2016

In this section, three broad topics will be discussed, population with disabilities and universal design, aging in place, and veterans with disabilities. In each of these topics, an awareness of a current and growing mobility need was recognized by elements of society. These needs often are complimentary:

1. Persons with disabilities have unique mobility needs depending on disabilities. Universal Design in physical space, products, services, and ICT figures into the needs of persons with disabilities, including both the aging in place and veterans with disabilities.
2. The older adults, for whom a growing percentage have come to expect that their later years will entail only minimal reductions in both their activities and interactions with society, hold both a place of great influence in spreading awareness because of their ubiquity as well as the economic wherewithal to drive market demand.
3. The needs of veterans with disabilities bring highly publicized awareness to certain types of disabilities and the desire of these veterans to, for example, return to an active life despite being an amputee. The development of solutions for these issues in turn has a complementary effect of potentially improving the lives of non-veterans who have similar needs, but for whom technology was either not developed or not marketed.

The research on this area indicates that there are existing initiatives to meet the needs of these populations, but that there remains a significant policy issue for meeting the awareness and products development needs of people with disabilities.

Besides the lack of awareness of users' needs among persons with disabilities, there is in general a lack of awareness of the overall impact of technology innovation for the disability community. The extent of impacts, from empowering individuals with disabilities to the economic and social benefits for their family, healthcare providers, and the greater community, are often not fully understood among policy makers and technology developers.

As stated previously, the ATTRI program focuses on five core technology areas: wayfinding and navigation, assistive technologies, automation and robotics, data integration, and enhanced human service transportation. Universal Design constitutes a conscious approach towards the development of user interfaces and space planning which broadly affects how users interact with wayfinding apps, enhanced human transportation, and the practical implementations of assistive technologies and robotics. In turn, the accessibility needs of older adults and veterans with disabilities are major emergent populations which each encompass design considerations which place their own unique requirements on what needs are being met, who technology is developed for, and how it is expected to perform.

2.1.1.1 Universal Design and General Awareness

Universal Design is a term describing a design philosophy which focuses on designing products, both physical products and ICTs, and spaces so that they can be used by the widest range of people possible. While Universal Design, with its inclusive design principles that make product developers aware of or encourage them to understand the needs of all potential users, theoretically addresses many of the awareness issues, it is not uniformly implemented and is imperfectly applied. Universal Design is an

evolution of Accessible Design, which meets the needs of people with disabilities.¹¹ Naturally, accommodating the “widest range of people possible” still requires some trade-offs. Recognizing that humanity exists along a spectrum of ability, some extreme accommodations may be uneconomical or exceed the actual idea of an item. The ideas of Universal Design overlap the requirements of the Americans with Disabilities Act (ADA) of 1990, seeking to integrate accessibility into the actual design philosophies underlying the layout of products and spaces from the beginning of the design process. Where the ADA might allow a circuitous ramp with limited slope to provide access to a place reached by a series of stair, applications of Universal Design might consider not even having stairs and simply having a long, aesthetically and conveniently laid out ramp for all visitors. These mechanisms have been developed through a number of institutions, such as government enforcement of the ADA, educational programs at universities that promote Universal Design, as well as efforts on the part of both market analysts and disability advocates to spread awareness to the general public. An example is the Center for Inclusive Design and Environmental Access at the State University of New York at Buffalo.

The policy issue regarding universal design is whether and to what extent an organization adopts the principles of universal design.

During the process of developing the Universal Design philosophy, a group of designers including the coiner of the term, collaborated in 1997 to release seven principles to guide Universal Design.¹² They are:

1. Equitable Use: the design is useful and marketable to people with diverse abilities
2. Flexibility in Use: the design accommodates a wide range of individual preferences and abilities
3. Simple and Intuitive Use: use of the design is easy to understand, regardless of the user's experience, knowledge, language skills: or current concentration level
4. Perceptible Information: the design communicates necessary information effectively to the user, regardless of ambient conditions or the user's sensory abilities
5. Tolerance for Error: the design minimizes hazards and the adverse consequences of accidental or unintended actions
6. Low Physical Effort: the design can be used efficiently and comfortably and with a minimum of fatigue
7. Size and Space for Approach and Use: appropriate size and space is provided for approach, reach, manipulation, and use regardless of user's body size, posture, or mobility

Each of these elements has several guidelines attached to them as explanatory subpoints. For example, principle six, Low Physical Effort, also calls for allowing the user to remain in a neutral body position while using reasonable operating forces and avoiding the need for repetitive or sustained physical effort.

¹¹ www.universaldesign.com/about-universal-design.htm, accessed January 1, 2016.

¹² https://www.ncsu.edu/ncsu/design/cud/pubs_p/docs/poster.pdf, accessed January 1, 2016

Many organizations and individuals are increasing their efforts to apply Universal Design elements to information and communication technology (ICT). ICT is expected to play an increasingly influential role in transportation, as it has since the 1960s.¹³ ICT is being implemented in three major ways:

1. streamlining and improving efficiencies within existing systems,
2. helping commuters connect with existing transportation solutions, and
3. disrupting the established transportation structure through the introduction of new players or the redefinition of the transport system itself.

ICT includes a broad range of technologies, ranging from traffic sensors, intelligent and automated traffic systems, as well as LTE, GPS, and other technologies that provide the underpinnings of TNC service apps such as Uber and Lyft.

Many accessible ICT products are available through a variety of manufacturers; one organization which has documented a number of these products is Tiresias.org.¹⁴ Some of the products that have been documented include ICT devices for audio playback, braille reading and writing, computer accessories, communications for the deaf and blind, electronic and internet reading devices, light and color sensors, medical devices, orientation and wayfinding, screen reading, and speech synthesizers. Another potential resource for people with disabilities to find suitable ICT products is the Global Public Inclusive Infrastructure (GPii)¹⁵, which is a program under development with the mission to enhance ICT accessibility by building a resource center of accessibility solutions for users.

Both the National Cooperative Highway Research Program (NCHRP) and Transport Canada have been involved in airport wayfinding research, while there are a number of startups such as 'Click and Go' which are attempting to provide pilot wayfinding projects for individuals with disabilities.¹⁶ The Transportation Research Board, the parent organization of the NCHRP, addresses issues of accessibility through the Standing Committee on Accessible Transportation and Mobility (ABE60), as well as a number of other committees as part of a broader portfolio of issues. Accessibility issues are further addressed through research projects that are selected through the Cooperative Research Programs, and encourage the participation of persons with accessibility needs as members of their committees and panels. The aim of the Transport Canada project was to make airports more accessible to travelers with sight, hearing, or cognitive disabilities by identifying effective wayfinding technologies and preparing a plan for implementing accessible wayfinding techniques and technologies in an airport terminal.¹⁷

G3ict¹⁸ – the Global Initiative for Inclusive Information and Communication Technologies, a United Nations' advocacy initiative to facilitate and support enhancing the accessibility of ICTs and assistive

¹³ <http://www.ericsson.com/res/docs/2014/ict-and-the-future-of-transport.pdf>, accessed January 20, 2016

¹⁴ <http://www.tiresias.org/research/devices/index.htm>, accessed January 1, 2016. While Tiresias.org's listing does not appear to be updated regularly, the listing itself is an indicator that there is a sizable market sufficient to support a number of manufacturers and retailers who wish to meet the needs of, if not all, certainly some sectors of persons with disabilities.

¹⁵ <http://gpil.net/>, accessed February 13, 2017

¹⁶ Based on results from stakeholder interviews.

¹⁷ <http://data.tc.gc.ca/archive/eng/innovation/tdc-projects-access-d-8932-287.htm>

¹⁸ <http://g3ict.com/>, accessed Jan 31, 2017

technologies, provides a comprehensive database of ICT accessibility policies and standards worldwide and latest publications on ICT accessibility issues.

The potential policy issue for the ATTRI program when it comes to Universal Design lies mostly in the field of awareness and deployment on both the part of the designers and users. It is clear that there is a will on the part of some designers to consider the needs of people with disabilities when designing mass market products, whether the focus is on accommodating muscular dystrophy or older adults. The salient point however is that to design effectively, designers must also have correct information on the accessibility needs of a person with disabilities. Projects similar to one undertaken by Transport Canada can play an important role by identifying opportunities for technology implementation and gaps in accessibility that can be addressed. If a product successfully implements the requirements of a sector of persons with disabilities, then the challenge is to ensure that users who would benefit from this product are properly informed of its capabilities and given a chance to reinforce its market success through adoption. Not only does this insert such products into the mainstream, but it also creates an opportunity for ATTRI to present accessibility priorities in technology or product development. Designers will then have a better idea of what kind of capabilities they should be making the greatest efforts to accommodate, which could potentially serve a greater number of individuals with a minimum of effort.

2.1.1.2 Aging in Place

Aging in Place is defined by the Centers for Disease Control (CDC) as “the ability to live in one’s own home and community safely, independently, and comfortably, regardless of age, income, or ability level.”¹⁹ Aging in Place seems to be primarily based on the concept that more and more of the newly older adults will be able to remain in the same homes and neighborhoods where they have lived for years. As increasing portions of the population become older, and in some cases develop specific vulnerabilities or disabilities, the built environment, as well as products that they use, must also compensate in order for them to maintain their relative quality of life. The key to aging in place is the ability to retain one’s autonomy and independence in conducting daily, routine activities, such as eating, bathing, dressing, cooking, and dealing with household chores. The number of adults aged 65 and over will nearly double over the next 20 years, and many will continue to live in their communities even with disabilities.²⁰ The AARP released a report titled “Beyond 50.05: A Report to the Nation on Livable Communities: Creating Environments for Successful Aging”²¹ as well as a research report titled “Aging in Place: A State Survey of Livability Policies and Practices.”²² These reports make a number of findings and recommendations that are relevant to encouraging the design and implementation of assistive technologies.

1. Individuals aged 50 and older who do not drive have significantly lower levels of mobility than those who drive.
2. Three quarters of persons aged 50 and over with a disability drive, compared to nine out of ten without a disability.

¹⁹ <http://www.cdc.gov/healthyplaces/terminology.htm>, accessed January 1, 2016

²⁰ <http://assets.aarp.org/rgcenter/ppi/liv-com/aging-in-place-2011-full.pdf>, accessed January 1, 2016

²¹ http://assets.aarp.org/rgcenter/il/beyond_50_communities.pdf, accessed January 1, 2016

²² <http://assets.aarp.org/rgcenter/ppi/liv-com/aging-in-place-2011-full.pdf>, accessed January 1, 2016

3. For persons 50 and older, nondrivers utilize public transportation for one in every six medical/dental trips, a rate 11 times that of the average driver.

To help aging adults meet the goal of aging in place, the Survey report makes some recommendations relevant to transportation, including the encouragement of Transit Oriented Development, Pedestrian Safety, Human Service Transportation Coordination, and the joint use of community facilities.²³ The Beyond 50 report makes a six point call to action with specific policy recommendations. The policy recommendations most relevant to the ATTRI program include suggestions to:

1. Promote the design and modification of homes that meet the physical needs of older individuals.
2. Facilitate driving by older individuals by improving the travel environment, supporting driver education, and promoting safe driving throughout the life span, and
3. Take positive steps to enhance mobility options, including public transportation, walking and biking, and specialized transportation for individuals with varied functional capabilities and preferences.

In particular, the policy implications for enhancing mobility options note that state and local jurisdictions should include the transportation needs of people with disabilities in state and local development strategies, involve citizens in short- and long-term planning, and coordinate all agencies with an interest in transportation and supporting infrastructure.²⁴

The Institute of Electrical and Electronics Engineers (IEEE) published a report titled “Aware Technologies for Aging in Place: Understanding User Needs and Attitudes”²⁵ This report examines computer technologies that would help facilitate the ability for aging in place. The technologies examined in the Aware Home Research Initiative at the Georgia Institute of Technology and described in the report include devices for compensating for physical decline, aiding the recall of past actions, and supporting the aging person’s recollection of extended family members. These technologies include wireless devices that would allow residents to issue commands to household devices (such as thermostats, lights, or doors) through hand gestures, and surrogate memory support through the use of ‘smart’ digital image collages of object-action chains. The report notes a substantial tension in the development and deployment of these assistive devices for users. There were concerns that the overreliance on assistive technology in any way would negatively impact a person’s sense of autonomy, as well as privacy and independence concerns about a device that was always on and monitoring their well-being or needs.²⁶ This type of response may indicate an indirect issue that the USDOT may wish to address as part of their outreach and education efforts. The ATTRI program seeks to develop and deploy technologies that improve the accessibility of people with disabilities. A natural byproduct of such technologies can also be

²³ <http://assets.aarp.org/rgcenter/ppi/liv-com/aging-in-place-2011-full.pdf>, accessed January 1, 2016

²⁴ http://assets.aarp.org/rgcenter/il/beyond_50_communities.pdf, accessed March 15, 2016

²⁵ <http://skeeter.socs.uoguelph.ca/~qmahmoud/teaching/fall2006/pervasive/aging.pdf>, accessed January 1, 2016

²⁶ <http://skeeter.socs.uoguelph.ca/~qmahmoud/teaching/fall2006/pervasive/aging.pdf>, accessed January 1, 2016

reluctance or fear on the part of users that they may come to be dependent on such technologies. Overcoming this fear may yield better results for technology adoption.

2.1.1.3 Veterans

Veterans are a significant and public component of persons facing difficulties from disabilities. The United States' involvement in protracted conflicts with low mortality rates since the early 2000s has caused the number of veterans with disabilities to rise. Between 2001 and 2008, the number of veterans with disabilities has jumped by 25 percent.²⁷ By 2013, approximately 21.4% of non-institutionalized civilian veterans aged 21 to 64 reported having a VA service-connected disability in the United States.²⁸ In some cases, veterans with disabilities are leading the charge for accessible technologies, with many seeking to reclaim a modicum of their previous lives before their traumatic injuries. Nearly 2,000 troops have lost one or more limbs from combat injuries in Iraq and Afghanistan, and these veterans want full independence. Improving technology and the growing demands and awareness of a veteran population returning from war have led to increased research and development on making higher quality and more versatile prosthetics for veterans, which are technologies which can apply to the general population with disabilities as well.²⁹ ³⁰ New techniques like 3-d printing and the use of advanced composite materials are allowing persons with disabilities to meet their own prosthetics needs.³¹ A range of companies worldwide is developing fully replaceable body parts for victims of war and human disease.³² The Department of Veterans Affairs sponsors one specialized event, a Prosthetics and Assistive Technology Challenge as part of its VA Innovation Creation Series, as a way to improve patient care and quality of life for veterans, create an open ecosystem of designs for prosthetics and assistive technologies, demonstrate the value of rapid prototyping and co-creation, and to spread an awareness of the VA's prosthetics and assistive technologies capabilities.³³ As part of this event, the VA challenge participants to develop designs or solutions to different problems, such as the design of upper extremity prosthesis devices for everyday use, or a device that would allow veterans with upper extremity injuries to remotely change the speed and grip strength of a prosthetic device. Other challenges include devices to assist individuals with fine motor tremors or assistive devices for improved hand eye coordination, fine motor control, and range of motion therapy.³⁴ While these devices are postulated in isolation, it is easy to see how improvements in one device could be applied to a number of different fields including transportation. For example, improving fine motor control, upper body strength, and reducing the effects of muscle tremors could assist a person with a disability in operating a vehicle more safely and reliably. The USDOT must decide how it will integrate these developments into its policy for developing and deploying accessible technologies. The relative visibility of veterans with disabilities and their accessibility needs is an area which can be coopted

²⁷ <http://www.cbsnews.com/news/number-of-disabled-us-veterans-rising/>, accessed January 1, 2016

²⁸ Erickson, W., Lee, C., von Schrader, S. (2015). Disability Statistics from the 2013 American Community Survey (ACS). Ithaca, NY: Cornell University Employment and Disability Institute (EDI). Accessed Jan 1, 2016 from www.disabilitystatistics.org

²⁹ <http://www.nydailynews.com/news/national/navy-studying-better-prosthetics-young-active-vets-article-1.1853451>, accessed January 1, 2016

³⁰ <http://blog.gettinghired.com/Home/tabid/159/entryid/118/advances-in-prosthetics-provides-unlimited-potential-for-transitioning-veterans.aspx>, accessed January 1, 2016

³¹ <http://www.disabledveterans.org/2015/10/02/vets-use-3d-printers-as-adaptive-tool/>, accessed January 1, 2016

³² <http://www.geektime.com/2016/01/04/5-bionics-and-biomedical-companies-working-to-rebuild-the-human-foot/>, accessed January 1, 2016

³³ <http://www.innovation.va.gov/challenge/>, accessed January 1, 2016

³⁴ Id.

by the USDOT in expanding its awareness and funding programs, as well as for pushing developers to respond to specific disability needs. However, there is also a risk that doing so can result in the disabilities of veterans having an outsized influence on what disabilities are addressed and who deployment is aimed at.

2.1.2 Funding

A direct way to address a defined need for accessible transportation technology is to fund the required research and development of the technology. Much of this assessment demonstrates that the research and development alone may not be enough for its deployment, but research and development are prerequisites. The transportation technology funding programs implement policies that must reflect awareness of the needs of travelers with disabilities. Potential improvements in these policies may include targeted new programs, but may also include refinement of independently funded policies that could be refined to better address the ATTRI goals. For example, machine and robotic cross-walk assistants may require substantial development and testing that exceeds the resources of any individual for-profit entity; when that conclusion is reached, a policy that provided for public funding of such a demonstrated need could substantially accelerate the development and deployment of the technology.

Funding issues include funding for the direct utilization of accessible technologies by persons with disabilities, for the development and deployment of advanced accessible technologies, and for addressing the barriers to that development and deployment.

Funding can be an issue for a person with disability. In conjunction with the associated medical costs, a disability can also make it difficult for a person to accrue the necessary income to afford specialized and potentially expensive equipment or products that make integrating into general society easier. In addition, one of the issues identified in this background report is that funding sources are fragmented. Persons with disabilities are sometimes not aware that certain funding sources exist, while other funds may be locked behind specific eligibility requirements or exist as tax incentives instead of direct funding assistance. In any case, the background research indicates that funding for accessible technologies is a policy issue that should be examined both in terms of scope, organization, and availability. This issue may have negative impacts on the ATTRI program by complicating efforts for deploying accessible technologies, regardless of success by the ATTRI program in identifying and encouraging the development of technologies. Because the target population of the ATTRI program encompasses a wide range of disabilities and economic means, it is likely that the ATTRI program must hope not to address every issue but to seek to cover the needs of the largest segment of the population with disability needs at the most economical means. Every individual who is unable to access ATTRI technologies due to insufficient funding will both decrease the cost effectiveness of any technology development and deployment effort, as well as lessen the overall impact of ATTRI technologies. Inability to access technology can be caused not only by a lack of financing but also by the user's inability to navigate and locate funding sources. A brief overview of existing funding sources and programs that follows illustrates the fragmented nature of accessibility funding.

A number of funding sources for people with disabilities are available both to employers as well as individuals. For employers, tax incentives such as the Work Opportunity Tax Credit, the Disabled Access Credit, and the Architectural and Transportation Barrier Removal Deduction help to cover the cost of

accommodating employees with disabilities and making facilities accessible. Information on these programs is available through the Internal Revenue Service.³⁵

Funding for individuals with disabilities includes scholarships, vocational training, and housing assistance. However there are many entities and programs that also assist individuals with disabilities with obtaining transportation and assistive technologies, such as computers and prosthetics. Transportation resources are available through charities or organizations focused on specific illnesses or disabilities such as the American Cancer Society, Goodwill Industries International, Mobility Unlimited, and the Department of Transportation's Disability Resource Center.³⁶ Many of the organizations assisting with the acquisition of computers are focused on channeling training and used or refurbished electronics to individuals with disabilities at reduced cost. A number of nonprofits are focused on providing funding and assistance for the acquisition of prosthetics, such as the Amputee Coalition of America, the Barr Foundation, and the United Amputee Services Organization.³⁷ A partial listing of these resources is available through the Job Accommodation Network (JAN).³⁸

The Assistive Technology Industry Association also maintains a resource for individuals and organizations seeking funding assistance, specifically for assistive technology.³⁹ The listing is very extensive, covering funding sources from organizations, insurance, federal and state sources, advocacy groups, vocational rehabilitation centers, grants, and other sources.

Under a program for Automobiles and Adaptive Equipment for Veterans with disabilities and Service members, the Department of Veterans Affairs provides a one-time payment to veterans with disabilities of no more than \$18,900 towards the purchase of an automobile or other transportation. Additionally, the VA will pay for adaptive equipment, or for the repair, replacement, and reinstallation of automotive equipment required because of disability. Payments for adaptive equipment may be made multiple times during the Veteran's life.⁴⁰

2.1.3 Research and Development

2.1.3.1 *Vehicle Automation and Integration*

Vehicle Automation and Integration is not the focus of this assessment, but there are extensive policy implications related to the development and implementation of such technologies for ATTRI outreach efforts. Major corporations and organizations such as Google, CityMobil2, and USDOT have undertaken active policy development work in this area, such as policy positions on the requirement for on-board

³⁵ www.irs.gov, accessed January 1, 2016

³⁶ <http://askjan.org/cgi-win/TypeQuery.exe?321>, accessed January 1, 2016

³⁷ <http://askjan.org/cgi-win/TypeQuery.exe?311>, accessed January 1, 2016

³⁸ <http://askjan.org/links/Funding/GeneralInfo.html>, this website does not appear to be regularly updated, but still provides a starting point for exploring the resources available for individuals with disabilities.

³⁹ <https://www.atia.org/i4a/pages/index.cfm?pageid=4219>, accessed January 1, 2016

⁴⁰ <http://www.benefits.gov/benefits/benefit-details/278>, accessed January 1, 2016

operators. How the policy work in this area is resolved will have broad implications for the development and implementation of new technologies for both immediate and long-term market use.

Automated features for vehicles have become a major factor in new transportation technology development over the past decade. Features such as collision detection, automatic braking, staying within traffic lines, and stability control, have piecemeal entered into the automobile market, both for persons with disabilities and for the general public. Several states in the United States now allow for the testing of automated vehicles on their roads, and regulatory entities have begun considering how to shape the requirements under which such vehicles would operate in the future. Notable automated vehicle testing projects include the Google Cars in California, as well as the Blind Driver Challenge, which is planned to allow a visually-impaired person to safely operate a motor vehicle.⁴¹ The National Federation of the Blind (NFB) incentivized research into accessible transportation technology by offering a prize competition. Furthermore, NFB promoted the competition across universities and held events to raise awareness of key issues. While the technology used by the Blind Driver Challenge is more extensive than the technology being developed for the general public, the range of non-visual driver interfaces offers a potential system for persons with disabilities to further benefit from the general development of automated vehicle technologies.

Public acceptance is one issue that may impact the speed of automated vehicle adoption. An interview aired by NPR on January 11, 2016, titled: “Self-Driving Cars are Coming, But are We Ready for Them?” reported that the public has a great deal of interest in automated vehicles, yet the largest concerns are about giving up control and that automated vehicles will not drive as well as the average human.⁴² Public acceptance is being researched and influenced by organizations like CityMobil2 and Fédération Internationale de l'Automobile (FIA). These organizations have published papers and worked with cities to understand public acceptance of automated vehicles.

There are issues associated with social equity and ensuring safety. An Article was posted in March of 2015 in the IEEE Spectrum, titled “Will You Need a New License to Operate a Self-Driving Car?” The article summarizes the issue facing California, where most of the currently operating automated vehicles in the US are operating. Self-driving cars theoretically allow a driver to turn into a passenger without any requirement of control or input into the vehicle during the trip itself. However, authorities are considering possible new requirements for automated vehicle operators, as the technology becomes more prominent and prevalent. The article notes that while British and Swedish authorities for example, do not currently require new requirements for the operators of automated vehicles, they are currently keeping open the possibility that new requirements may be needed as automated vehicles become a more widespread presence in transportation systems. If new requirements are introduced for automated vehicle operators, such as a special license or responsibilities of a traditionally licensed operator, that may create barriers for persons with disabilities to benefit from the technology. Meanwhile, it is unclear to policy makers whether self-driving technologies will become default or luxury options in production vehicles, making it

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http://ieeexplore.ieee.org/xpl/login.jsp?reload=true&tp=&arnumber=4648051&url=http%3A%2F%2Fieeexplore.ieee.org%2Fxppls%2Fabs_all.jsp%3Farnumber%3D4648051, accessed January 20, 2016

⁴² <http://www.npr.org/sections/alltechconsidered/2016/01/11/462694123/self-driving-cars-are-coming-but-are-we-ready-for-them?> , accessed January 1, 2016

difficult to determine how widespread such features will be for the general public. But as long as automated vehicles remain a luxury option, affordability is a major barrier for persons with disabilities.

There are also significant policy efforts underway for the research, development, and implementation of automated vehicles. According to information collected by the University of Stanford, a number of state legislatures have considered or passed bills related to automated driving testing, driver/vehicle certification, and operation. California, Nevada, Michigan, the District of Columbia, and Florida have successfully passed bills.⁴³ The National Highway Traffic Safety Administration (NHTSA) released a Preliminary Statement of Policy Concerning Automated Vehicles in 2013⁴⁴, and policy guidance updating the Preliminary Statement was released by the Department of Transportation in early 2016.⁴⁵ NHTSA published Enforcement Guidance Bulletin on Automated Vehicle Technologies⁴⁶ and established the Advisory Committee on Automation in Transportation⁴⁷ in 2016. The Rand Corporation also published a Guide for Policymakers for Autonomous Vehicle Technology in 2014. The report surveys the advantages and disadvantages of the technology and explores policy issues, communications, regulation and standards, and liability issues related to the technology.⁴⁸

Vehicle automation, vehicle design and infrastructure integration of information is an area of concern for the ATTRI program. The technologies required for partial or fully automated vehicles involve several of the prime technologies that are the focus of the ATTRI program, including wayfinding and navigation, and robotics. Vehicles must have competent artificial intelligences that are able to distinguish obstacles, pedestrians, other vehicles, and to make decisions leading to safe, accident-free trips. Wayfinding and GPS are required so that vehicles are able to move from one point to another without getting lost. By its nature, automated vehicles are essentially robots, placing an artificial intelligence in charge of controlling the position, speed, and maneuvering of a vehicle. Finally, automated vehicles are eventually envisioned to incorporate significant communication technology that will help to coordinate vehicles with each other and their built environment. One concern of adopting such technologies in automated vehicles for users with disabilities is accessible vehicle design. The concept of self-driving vehicle may seem to be a favorable mobility solution to persons with disabilities, but if the vehicle design is not accessible, persons with disabilities may not benefit from the product. For example, vehicle design must take into consideration accessible passenger-vehicle interaction that allow passengers to interact with the vehicle in multiple ways, depending on the passenger's disability and needs. How the ATTRI program receives and converts these developments may have long term effects on how these technologies are eventually deployed, even outside of automated vehicles themselves. As a result, the ATTRI program should look at how to integrate accessibility into such technologies at an early stage, how to nurture and encourage continued development of automated vehicles, and how to resolve the operation of such vehicles such that they provide a mainstream solution for the accessibility needs of persons with disabilities so that a minimum financial and operational burden is placed on users. As noted by the members of the US Access Board, when the mainstream demands something, it tends to happen. Piggybacking accessibility

⁴³ http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action, accessed January 25, 2016

⁴⁴ http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf, accessed January 25, 2016

⁴⁵ http://cyberlaw.stanford.edu/wiki/index.php/Automated_Driving:_Legislative_and_Regulatory_Action, accessed January 25, 2016

⁴⁶ <https://www.gpo.gov/fdsys/pkg/FR-2016-09-23/pdf/2016-23010.pdf>, accessed on January 31, 2017

⁴⁷ <https://www.federalregister.gov/documents/2016/10/20/2016-25392/advisory-committee-on-automation-in-transportation>, accessed on January 31, 2017

⁴⁸ http://www.rand.org/pubs/research_reports/RR443-1.html, accessed January 25, 2016

technology into mainstream demand for a product is one way for the ATTRI program to address potential deployment issues.

2.1.3.2 Development Incentives

A number of development incentive policies exist to encourage participation in the market. Small Business Innovation Research (SBIR) grants are administered through the Small Business Administration, and are intended to support research and develop efforts by small businesses. Funds are drawn from the research and development budgets of 11 federal agencies with extramural funding in excess of \$100 million, with a total of approximately \$2.5 billion disbursed every year. The program divides development cycles into three phases: 1) startup and feasibility, 2) evaluation for commercialization, and 3) moving from the laboratory to the market, and provides possible funding for phases one and two, in the amounts of \$150,000 for six months and up to \$1,000,000 for 2 years, respectively. SBIR funding cannot be provided during phase 3, when it is expected that private or other non-SBIR funding is available. A number of SBIR programs have been aimed at accessible transportation, for example DHHS awarded an SBIR Phase 2 to improve accessibility of transit information systems through social-networks-based techniques in 2015. Other development incentive policies and programs include the FHWA Exploratory Advanced Research Program, committed research funding for technology deployment through Broad Agency Announcements (BAAs) by the ATTRI Program with the Intelligent Transportation System (ITS) Joint Program Office (JPO) and the Federal Transit Administration (FTA), and ATTRI's recent partnership with Department of Health and Human Services and National Institute on Disability, Independent Living, and Rehabilitation Research (NIDILRR).

The Small Business Technology Transfer Program (STTR) works on a similar basis with the SBIR program, except between private industry and American nonprofit research institutions. The program also draws funding from other federal agencies with significant research budgets, but allows small businesses to partner with nonprofit research institutions, who are required to receive at least 30% of the disbursed funding.

Ensuring that more companies enter the market may be an issue worth examining, as in general, greater economic involvement would improve both the service that consumers receive as well as reduce the eventual costs of such technologies as products become more mainstream rather than specialized. An interviewee noted that there are challenges in providing development initiatives because of a relatively small market and limited profit, however there are pockets of opportunity, citing the Smart Cities Challenge, Mobility on Demand Sandbox Program, as well as some discretionary programs in the FAST Act.⁴⁹ More companies, including traditional private for-profit companies and social enterprises, are deciding to enter the market for serving persons with disabilities. In part some of these efforts have begun because of a perception of an existing market among the general public that also serves individuals with disabilities. An example of this is the automated vehicle market. While the features of automated vehicles would assist individuals with disabilities greatly through the elimination of the need for their personal control and attention during transit, the greater demand for automated vehicles has come because of incremental developments in vehicle automation that are desired by the general public. Driving lane

⁴⁹ Based on results from stakeholder interviews.

assistance, automated parking, GPS wayfinding and navigation, and the move towards fully automated vehicles have all been marketed as incremental luxury perks instead of necessities by vehicle and computer companies.⁵⁰ Encouraging technology developments that have positive applications for accessibility is an issue for the ATTRI program for two fundamental reasons. The ATTRI program, to be successful, must seek to not only identify but also deploy ATTRI technologies. Integrating accessibility needs into technology development early lowers the costs relative to later retrofits; however the biggest benefit is that new developments which have mass market appeal are the easiest way to encourage private companies to take the risk of developing those technologies. Ensuring that new technologies being deployed are useful not only for the population in general but also people with disabilities will help both the social acceptance and conversely the market reach of accessibility technologies.

A study by the Swedish government found that the cost of providing individuals with mental disabilities with assistive technology was recovered within one and a half years.⁵¹ While the applicability to assistive transportation technologies is not certain, the advantages of the technologies for persons with mental disabilities seem to apply or be heightened for transportation technologies.

A technology assessment of the US Assistive Technology industry conducted in 2003 found that there will be a strong, steady increase in demand for a broad spectrum of assistive technology devices, ranging from canes to advanced wheelchairs to automobiles and communications devices. Sales by companies producing assistive technology products and services increased 22 percent between 1997 and 1999.⁵² Given the demographic trends which this assessment cites, it is logical that demand has only increased as the population continues to age and more veterans continue to return to the United States.

The AAPD published a report titled *Equity in Transportation for People with Disabilities* in 2010, which summarizes some of the challenges facing people with disabilities. In it, the AAPD noted that transportation choices for the persons with disabilities are still limited despite significant progress in expanding services for people with disabilities on public buses and train systems. In particular, the AAPD notes that Universal Design features such as low-floor buses with ramps, larger destination signage, floor markings, additional grab bars, and monitors that show upcoming stops have greatly expanded the ability of persons with disabilities to travel. However, they also note that there are inconsistencies with compliance for fixed route transit providers, particularly in how or if they provide information to travelers with disabilities in enough advance that they are able to plan their travel. This extends both to immediate time scales where riders are not informed that their stop is imminent, as well as to more long term planning, such as that involved when elevators, escalators, or other means of accessing transportation are out of service.

Paratransit is another area singled out by the AAPD for imposing accessibility challenges on the persons with disabilities. Paratransit is broadly any form of transportation that is close to fixed route, fixed schedule transit service (common bus and train service), but differs in significant ways such as being demand responsive, user operated, or serving limited populations. In this report and commonly, “paratransit” refers to the paratransit service offered by fixed route operators to complement their fixed

⁵⁰ <https://www.youtube.com/watch?v=ihsa3H7Awp8>, accessed January 1, 2016

⁵¹ http://www.rolltalk.com/userfiles/46188/Cost-benefit_assessment_of_assistive_devices.pdf, accessed January 1, 2016

⁵² https://www.bis.doc.gov/index.php/forms-documents/doc_view/701-technology-assessment-us-assistive-technology-industry-2003, accessed January 1, 2016

route service and provide an alternative for persons who cannot use the fixed route service because of a disability. In balancing the requirements of efficiency and cost against the unpredictable nature of requests, these services often utilize smaller minibus-type vehicles or bodies on truck chases. The use of paratransit has grown dramatically since its inception, and in some cases comprises a significant portion of the operating expenses of transit agencies. However, users have also registered some complaints about paratransit, including restrictive eligibility criteria, 24-hour reservation requirement, unfair trip denials, unreliability or slowness of services, inaccurate information, and untrained drivers. Such constraints make it very difficult for persons with disabilities to plan their schedule with any flexibility or to make changes to planned trips. The report also makes note of the importance of the private taxi system, which provides a cost-effective alternative to the paratransit system, although one which also poses challenges. Few private taxi vehicles are accessible, and there are cases of discrimination where drivers will refuse to pick up passengers with disabilities.

Enforcing compliance can be an issue, since ADA enforcement is complaint-driven. This is noted as a potential issue for people with disabilities, particularly in rural areas. In years where the FTA conducted compliance assessments where there were concerns about ADA compliance, significant service improvements were reported. Compliance extends not only to making vehicles accessible, but also in ensuring that pedestrian rights-of-way are accessible. Ensuring a consistent application of accessibility rules and the implementation of underlying support infrastructure may be a key issue for improving the public acceptance of, and may assist in encouraging the development and implementation of advanced technologies in the future. In essence, ensuring that private and public facilities are properly compliant creates an ambient environment that the population will accept as normal. By normalizing the social attitude that public accommodation of persons with disabilities is to be expected and is “the right thing to do,” there are both secondary effects in which withholding such accommodations is seen as undesirable, and brings the issue to the forefront of the public consciousness. While there is a risk that compliance can also cause a sense of complacency on the part of policy makers or even the public because of a perception that accommodations have been successful, enforcing compliance should not be discouraged for this reason.

The AAPD report also contains information on funding for local transportation programs. Several federally funded programs listed are useful for people with disabilities. One of these programs is The Transportation for the Older adults and People with Disabilities Program (Chapter 5310), which provides funds to states for private nonprofit groups to provide transportation for the older adults and persons with disabilities when public transportation services are insufficient for their needs. The Job Access Reverse Commute Program (Chapter 5316), which provides transportation to and from work for low-income individuals, does not specifically target people with disabilities, but programs servicing the community of those with disabilities have received federal funding. The New Freedom formula grant program (Chapter 5317), funds new public transportation services beyond those required by the ADA to assist individuals with disabilities. These services include mobility management programs and vouchers. Mobility management programs recruit members of the community to coordinate transportation for people with disabilities using all types of transportation, taking into account the age, income, and accessibility needs of the rider. Vouchers allow riders to use them as full or partial payment for certain transportation options, effectively serving as a form of public subsidy that can be applied flexibly to more appropriate transportation services, such as taxis and other transportation providers. The Mobility Services for All Americans (MSAA) program funds improvement of accessible mobility through application of ITS in selected locations.

The Victoria Transport Policy Institute issued a report on December 10, 2015 titled **Evaluating Transportation Equity: Guidance for Incorporating Distributional Impacts in Transportation Planning**. One of the categories of people considered include those with disabilities, and the report looks at a variety of impacts to transportation equity which affect people with disabilities disproportionately. As part of this report, a number of transportation planning and management strategies noted to have potential for achieving transport equity for persons with disabilities include:

1. Increased transportation system diversity,
2. More accessible land use and location-efficient development
3. Policies which favor automobile travel over other modes (planning and investment reforms.
4. Improved public involvement in transport planning, and
5. Improved data collection (more information on disadvantaged people and alternative modes).

The ATTRI program can also consider the impact of these strategies on its policies going forward. While strategies such as accessible land uses are more infrastructure related, public involvement in transport planning and data collection infer a more institutional level policy issue in how transportation is planned and implemented.

2.2 Institutional Issues

By “institutional issues” this research means issues that pertain to the actions or inaction of organizations rather than individuals. While economic activity is carried out and determined to a large extent by the cumulative result of individual actions, institutions influence individuals actions, and changing an institutional policy, practice, or motivation may advance technological development.

2.2.1 Transportation Network Company (TNC) Accessibility

TNC’s such as Uber and Lyft are defined by the Transportation Research Board’s (TRB’s) recent report on innovative mobility services⁵³ as services that provide reservations and tracking of vehicles, billing, and quality control in either concurrent (pooled rides) or sequential (private rides) modes. These are the most rapidly emerging major technologies in transportation, and represent a type of crowd-sourcing of transportation that present both challenges and opportunities for persons with disabilities.

The TRB report suggests that as the largest operators in the TNC industry, Uber and Lyft are likely to play central roles in addressing issues of access for people with disabilities. So far, TNCs’ efforts to partner with transit operators in providing paratransit services have seen mixed results. Uber approached the City and County of San Francisco, for example, to take over the city’s paratransit services for the older adults and those with disabilities. Because of unresolved insurance issues on how much liability TNC drivers are

⁵³ <http://onlinepubs.trb.org/onlinepubs/sr/sr319.pdf>, Between Public and Private Mobility,

protected from, however, those talks did not culminate in an Uber/San Francisco agreement of that scope at that time. More recently in Boston, a one-year pilot program has started between TNCs (Uber and Lyft) and the Massachusetts Bay Transportation Authority (MBTA). The program will cost less for riders (\$2 at the beginning of their trip and the rest of fare above \$15) and could save the MBTA \$10 million annually.⁵⁴ A similar partnership between the Washington Metropolitan Area Transportation Authority (WMATA) and Uber and Lyft will be rolled out in March, 2017.⁵⁵

Uber also has created a variation of its service, known as UberWAV, which provides wheelchair-accessible vehicles (WAVs) as a specific request option. UberWAV connects riders with wheelchair-accessible “boro taxis” in the outer boroughs of New York City. Payment is not made through the Uber app; instead, it is made to the driver as in traditional taxi transactions. In mid-2015, Uber introduced UberAssist in Los Angeles, a service that offers drivers with special training and vehicles capable of handling wheelchairs, walkers, and scooters. Similarly, Lyft allows users to enable an “Access Mode.” Both of these services dispatch vehicles that are specially outfitted to accommodate wheelchairs, typically at a cost that compares with that of limousine or UberBlack service.

Two significant and related institutional issues have been raised regarding TNC development. The first is that the basic Uber app does not interact with public paratransit systems and as the San Francisco experience indicates, there has been a remarkable lack of success in arranging for ADA required service to utilize the TNC providers. The second issue is one aspect of this lack of success which relates to data standards, and that will be addressed in upcoming TRB research: “TCRP Project G-16 Development of Open Data Standards for Demand Responsive Transportation Transactions.” This research will address the “importance of interregional, intermodal, interagency, interoperability of mobility on demand (i4MOD) at the national level, spurred on by the extraordinary growth of Uber and Lyft in the DRT marketplace.”⁵⁶ These two issues represent significant barriers to development of accessible transportation technology because of (1) the significance of ADA required paratransit service to persons with disabilities combined with (2) the significance of TNC technology.

TNC technology has encroached on the market of traditional taxi companies with unprecedented speed, threatening the market reach and economic viability of traditional taxi companies. This is a potential issue for the ATTRI program because TNC deployment also threatens existing arrangements that many transit providers have with taxi companies that call on the taxi companies to provide a certain level of accessibility access. Accessibility requirements do not apply to TNCs, and in some cases are statutorily requirements addressed specifically to taxi companies. Replacing lost accessible taxi service is an huge concern for local jurisdictions⁵⁷, and should be an immediate concern for the ATTRI program. However, this is also an opportunity to implement innovative institutional arrangements that can fulfill accessibility needs while remaining flexible in the face of shifts in the market providers. Finally, TNC companies rely on technologies that are a focal point of the ATTRI program, touching on wayfinding, local distributed networking, and digital app technology. With the increasing ubiquity of smartphones and staying online, this will pose a policy challenge as public agencies seem to form new relationships for providing

⁵⁴ <http://news.wgbh.org/2016/09/19/politics-government/mbta-partners-uber-and-lyft-paratransit-ride-pilot-program>

⁵⁵ <http://wtop.com/tracking-metro-24-7/2016/09/metroaccess-alternative-looks-pay-uber-lyft-rides/> “MetroAccess alternative pilot program would pay for car-sharing rides”

⁵⁶ <http://www.trb.org/main/blurbs/173682.aspx> “Announcement of FY 2016 Transit Research Projects”

⁵⁷ Based on results from stakeholder interviews.

accessible transit. As noted by Neil Pedersen of the TRB, the appropriate jurisdictional level for regulating TNCs is unsettled; their networks are standard and international.

2.2.2 Voluntary Standards

The literature and interviews confirmed that establishing standards and regulatory regimes is a potential institutional issue that will affect the development and deployment of accessible technologies in the future, as it does now. Various national governments and international bodies have implemented different standards regimes for their populations, and such bodies do not always agree or enforce those standards to the same degree. In part, this requirement for regulations and standards is met in the United States by the technical requirements set forth in the Americans with Disabilities Act and similar legislation, as discussed in the Regulatory Environment section subsequent; however, there is currently no broad private consensus on technical requirements for accessibility beyond that which is legally mandated of them. This background research has identified that a potential institutional issue is the lack of a broad private industry set of standards which meets the needs of consumers while remaining above and beyond the basic technical requirements of legal regulations. A number of interviewees indicated that there are relatively few standards covering next vehicle displays, cell phone technologies, and other applications.⁵⁸ Several bodies are in the process of attempting to create such standards, but their work is not widely accepted within the industry as the “de facto” standard to adhere to. Addressing this issue may encourage future development and deployment of accessible technologies for transportation as there is a broad base of interoperable and non-proprietary technologies to support new products. A lack of a consistent standards regime will impact the ATTRI program because differing technologies will have differing interaction requirements. This complicates development by both large and small companies as competing standards may compete for market supremacy. An example of this industrial conflict between technology standards is the VHS/Betamax competition, which ended with the market exit and functional obsolescence of Betamax products. While there may be workarounds or intermediate technology that can bridge differing standards, setting functional standards early and ensuring their adoption for the biggest market share of users possible will help to ensure that persons with disabilities do not face the prospect the accessible technology they use becomes abandonware as the market shifts and new products and updates come online.

In the US, an example of voluntary consensus standards are being coordinated comes from the RESNA Assistive Technology Standards Board (ATSB), which is accredited by the American National Standards Institute and currently hosts a number of standards and ISO committees. Some of the Standards Committees for the ATSB support Assistive Technologies Standards, Cognitive Technologies, Assistive Technologies for Persons with Vision and Hearing Impairments, and Wheelchairs and Transportation. Some of the ATSB ISO Committees focus on areas related to Assistive Products for Persons with Disabilities, Wheelchairs, Orienting the visually impaired in pedestrian areas, Wheelchair seating, and Wheelchair Restraint Systems.

The Access Board interviewees suggested a potential consensus that stronger incentives for technology developers to adopt accessibility standards particularly for mobile application interfaces are warranted.

⁵⁸ Based on results from stakeholder interviews.

One approach to incentivize adoption of accessibility standards is through a certification program with wide industry and consumer recognition. The program should provide a system of certification that verifies and/or rates a product's or service's accessibility features based on established standards, e.g. ADA standards. A program like this, coupled with nation and industry wide recognition, would effectively enhance awareness of disability needs among product designers and service providers. It would also help consumers with disabilities to make informed selection of products and services. Analogous examples of certification programs include Underwriters Laboratories, which certifies product safety, the Non-GMO Project, which certifies non-GMO (genetically modified organism) food products, and U.S. Green Building Council, which certifies energy efficient and environmentally friendly building designs. Several certification programs exist in the United States and globally today for specific product and service categories.

The Accessibility Pass is a global third-party certification program for hotel and conference centers which attempts to objectively and reliably assess the infrastructure and services in place for all guests.⁵⁹ The program issues accessibility information for senior citizens, people with motor, visual, hearing, or cognitive disabilities, and people with temporary accessibility needs such as pregnant women and recently injured individuals. Some of the disability types considered by the Accessibility Pass include blindness, deafness, cerebral palsy, dementia, Asperger's syndrome, spinal paraplegia, and disabilities requiring the use of wheelchairs. It uses on-site audits and integrates 6 national standards and 22 international guidelines on accessibility to issue one of four certification levels to a facility. The auditing process also tests personnel skills in addition to physical infrastructure such as elevators and ramps, and successful certifications last for a period of one year after the date of the audit. The Accessibility Pass maintains a list of all certified vendors on its website, along with lists of their accessible features.⁶⁰

In the United States, a pilot certification program in Oregon called "Lifelong Housing Certification Project" assesses the "age-friendliness" and accessibility of both newly constructed and existing homes. If a home passes the evaluation, the certificate remains with the property owner.⁶¹ There are companies in the US that help businesses and government agencies with their websites to be ADA compliant⁶² and to certify ADA accessibility⁶³. However, technology developers would have greater incentives to voluntarily meet consensus standards if their products and services are certified through a program with wider recognition.

2.3 The Regulatory Environment

A number of laws and regulations have been passed and implemented within the United States which affect the development and deployment of accessible technologies. This section will briefly summarize those domestic laws and regulations which most clearly affect people with disabilities, in addition to international regulatory regimes, both implemented and proposed, which may come to affect developments of accessible technologies. Like a consistent standards regime, consistent regulatory regimes offer a stable environment in which providers will be more willing to enter, while protecting consumers from extreme market shifts. The ATTRI program may have a role in shaping a consistent

⁵⁹ <http://www.accessibilitypass.org/FAQs>, accessed January 1, 2016

⁶⁰ ACCESSIBILITY PASS Public Registry (/download/2852204f-c681-11e4-99ca-b3919ed1843d/), accessed January 1, 2016

⁶¹ <http://www.aarp.org/livable-communities/housing/info-2015/how-to-encourage-more-lifelong-housing.html>

⁶² <http://www.interactiveaccessibility.com/services/accessibility-certification>

⁶³ <http://webaim.org/services/certification>

domestic, as well as international regulatory regime that more fully integrates the needs of persons with disabilities into the framework of laws that consumer products operate in.

Understanding both the domestic and international regulatory issues is important because it can shape current and future collaboration on the needs of people with disabilities. As economic entities become increasingly interdependent, and products and services are not limited to the nearby, it is foreseeable that entities developing accessible technologies would wish to do so in a manner which conforms both to domestic regulations as well as international one. As a matter of pragmatic institutional policy, implementing a broadly acceptable standards regime would ease the development and interplay between technologies developed by different organizations, promoting widespread adoption and use of new products as consumers are more easily able to access and evaluate new products without investing significant amounts of time or money into proprietary tools. Economically, ensuring that standards used throughout the world are not too dissimilar will allow designers to comply with the requirements of different jurisdictions with minimal changes to their products, ideally, to create a product following universal design principles which need not be altered for use between different jurisdictions at all. Many of these regulations cover accessibility in general, including infrastructure, which intersects broadly with the ability of persons with disabilities to access transportation. Socialization of technologies and standards internationally will help promote collaboration and coordination among countries and regions, especially those with limited involvement with the U.S.

In the case of transportation specifically, the issue of automated vehicles is now becoming an issue for regulatory entities both within the United States and abroad. The National Highway Traffic Safety Administration (NHTSA) proposed a formal classification for automated vehicles on a scale from 0 to 4.⁶⁴

This section will examine international conventions, treaties, and practices, followed by domestic laws and regulations of the United States, and conclude with a short summary of privacy regulations, which will be elaborated on in more detail in a future report.

2.3.1 Inconsistent Laws Issues

There are significant legal issues arising from the number of different jurisdictions which are involved in regulating accessible technologies. These extend across local, state, and national and international entities, as well as within each government as well (for example, a state Department of Motor Vehicle versus a state Department of Transportation). Disharmonious legal regimes have already emerged across these jurisdictions that will require manufacturers to meet different requirements in different regions and ICT and service providers to comply with region specific rules. This type of patchwork legal framework has the potential to impeded deployment. In part because of the developmental nature of accessible

⁶⁴ Level 0 vehicles are fully manual control, level 1 vehicles have individual automated vehicle systems such as stability control or automatic braking, level 2 vehicles have at least two systems which are automated in unison, level 3 vehicles allow the driver to relinquish manual control completely but retain the ability to reassume control in necessary conditions, and level 4 vehicles are fully automated without the requirement for a driver.

technologies, new technology and techniques offer benefits to persons with disabilities while simultaneously presenting challenges to regulators and consumers alike.

As reported by the Wall Street Journal, the US Department of Transportation recently announced a \$4 Billion program across ten years in order to implement consistent laws across all states for automated vehicles.⁶⁵ The proposal aims for federal regulators to work with auto makers and others to craft policies and rules for automated vehicles, and to set up pilot programs for connected vehicles, and is expected to issue guidance on preferred performance characteristics and testing methods for automated vehicles.

There are also questions of operator liability, for example determining who has responsibility for post-crash actions when there is no driver (unoccupied vehicle, freight vehicle, or automated taxi with non-driving passengers)..

These legal issues are salient in regards to automated vehicles because of the pace with which private developers have been rushing to implement automated vehicles. Although automated vehicles are not explicitly related to accessible technologies for persons with disabilities, their relative utility for persons with visual or mobility disabilities is such as these legal questions may have a disproportionate impact on travelers with disabilities. Current vehicle regulations focus primarily on safety features such as airbags and crash safety, and the functionality of vehicles means that persons with disabilities tend to be less able to operate private vehicles. The widespread adoption of automated vehicles may change that however, and ensuring there is a consistent legal regime governing their use and operation will go a long way towards ensuring their utility for persons with disabilities.

An article published in the Texas A&M Law Review in 2014 noted, “A state department of motor vehicles might determine that certain disabilities do not prevent the safe operation of an automated vehicle, a state legislature might amend the relevant statutory provisions, or a person denied a license might challenge those provisions or their application as a violation of the state or federal constitution (particularly due process or equal protection guarantees) or the federal Americans with Disabilities Act (ADA).”⁶⁶

In an interview with Adriano Alessandrini, CityMobil2 reported that conflict among European jurisdictions (both national and subnational) was a major impediment to development of automated vehicle technology in Europe. He noted that in each of the five demonstrations of the Citymobil2 project so far, each was located in a different jurisdiction with different compliance requirements. Moving forward, implementing a similar system across such disparate bureaucratic and jurisdictional barriers could face huge problems.⁶⁷

For ICT and service providers, inconsistent legal requirements would increase deployment costs and reduce product utility. For example, laws of some states (e.g. Pennsylvania) require users to schedule paratransit services with 24-hour notice, which would greatly reduce the advantages and potential of TNCs in providing paratransit services.

⁶⁵ <http://www.wsj.com/articles/obama-administration-proposes-spending-4-billion-on-driverless-car-guidelines-1452798787>, accessed January 20, 2016

⁶⁶ Bryant Walker Smith, Automated Vehicles are Probably Legal in the United States, 1 Tex. A&M L. Rev. 411 (2014)

⁶⁷ Based on results from stakeholder interviews.

Legal issues do not arise as significantly for other applications of technology for persons with disabilities, though they do still exist as new technologies are applied to existing needs. Examples of this include wayfinding for the blind, as well as the general product liability arising as a result of using a ‘universally-designed’ product. For example, if an aural or voice app directs a blind person across a zone with an open manhole, and the individual is therefore injured in a fall, the question would exist as to who would be most liable for the harm suffered by the individual. Would the maker of the app or the provider of the data used be found more responsible? There may even be some contributory negligence on the part of the blind individual, or interference from external noise sources, but to what degree would each party be held responsible? An interviewee with the FHWA who was involved in policy issues indicated that to their knowledge there were no current discussions on reducing the level of liability, but that there were some possible attempts to obtain relief from liability for research efforts in general.⁶⁸ ATTRI may play a part in examining the development of these legal issues that arise out of normal day-to-day usage of the technology.

2.3.2 International Conventions, Treaties, and Practices

In 2011, the EU ratified the **UN Convention on the Rights of Persons with Disabilities**. The United States signed the Convention in 2009, but has not ratified the Convention for official participation despite broad support by disability advocates and civil rights organizations. Objections include its similarity with the Americans with Disabilities Act, which has been in place for decades, as well as concerns about maintaining U.S. sovereignty. At least 150 countries have ratified the disability treaty. The purpose of this Convention is to promote, protect, and ensure the full and equal enjoyment of all human rights and fundamental freedoms by all persons with disabilities and to promote their inherent dignity. The Convention calls for non-discrimination of the persons with disabilities, recognition of their individual autonomy and freedom of choice, their full and effective participation and inclusion into society, respect for their differences, equality of opportunity, accessibility, and their right to preserve their identities. States party to the Convention accept a number of obligations, among them the obligation to adopt or repeal legislative, administrative, and policy measures to remain in line with the rights recognized in the Convention, as well as the promotion of research and development for universally designed goods and services as well as promoting the availability of new accessible and assistive technologies for persons with disabilities with a priority for those of an affordable cost. Article 8 of the Convention calls for States party to the Convention to undertake appropriate measures to raise awareness throughout society for persons with disabilities and to combat stereotypes about disabilities. Article 9 deals specifically with Accessibility. States are required to ensure people with disabilities have access on an equal basis with others to the physical environment, transportation, information technology and communications, and to other facilities and services open or provided to the public. These measures apply to areas such as roads, transportation, information, communications, and electronic services. The Convention calls on States to develop and implement minimum standards for the accessibility of facilities and services open to the public, to ensure that private entities take accessibility into account for their facilities and services, and to provide training for stakeholders on accessibility issues. Article 9 also requires states to provide or promote appropriate forms of assistance and support to persons with disabilities to ensure their access to information, to promote access to new information and communications technologies and systems, and to

⁶⁸ Based on results from stakeholder interviews.

promote the design, development, production, and distribution of accessible information and communications technologies in a way that these technologies become accessible at minimum cost.

Previously in 1994, the UN General Council adopted a resolution on the **Standard Rules on the Equalization of Opportunities for Persons with Disabilities**. It recognizes that among the preconditions for equal participation are awareness, medical care, rehabilitation, and support services. It targets accessibility, education, employment, and other areas for equal participation, and calls for implementation measures ranging from research to policy and legislation to personnel training and international cooperation between states.

The World Health Organization issued a **World Report on Disability** in 2011. The Report, which systematically defines and measures disabilities by country and demographic, also breaks down the concerns and state of people of disabilities in regards to general health care, rehabilitation, assistance and support, accessibility in information and transportation, education, employment, and closes with recommendations for moving forward on disabilities.

The Hartford Courant reported in October of 2015 that a new, modernized International Symbol of Accessibility has been slow to be adopted. New York adopted it in 2014, as well as cities such as Phoenix and El Paso, but the FHWA rejected alternative dynamic designs on traffic signs and pavement markings, and the International Organization for Standardization has argued against adopting the new design because the old design is universally recognized. Backlash has come from both inside and outside the community of those with disabilities, as some disability rights activists believe the new symbol “seems to say independence has everything to do with the body... ... Independence is who you are inside.” Resistance has also come because some countries have a reputation for misusing the handicapped symbol, placing it in locations which are not handicapped accessible.

The European Union published a roadmap for the **European Accessibility Act** in 2012. The Act is intended to improve the accessibility of goods and services in the Internal Market. The initiative is part of the multiannual European Disability Strategy 2010-2020, and will address complaints, supported by research, that show that there are not enough accessible goods and services on the EU market and that weak enforcement and the individual initiatives of member states for defining standards for individuals with disabilities causes increasing barriers to the free movement of accessible goods and services. Around 80 million people in the EU have a disability of some kind, and with the increasing age of the population this is expected to increase to 120 million by 2020. Accessibility is therefore seen as a major pillar of ensuring smart, sustainable, and inclusive growth in the EU. As of December 2, 2015, the EU Accessibility Act has been proposed by the European Commission. The products and services covered by the Accessibility Act were selected by their relevance to the public, taking into account the obligations deriving from the UN Convention on the Rights of Persons with Disabilities and consultations with stakeholders and experts. The products and services covered by the directive include: computers, operating systems, ATMs, ticketing machines, smartphones, digital television equipment, telephones, audiovisual services, passenger transportation services, banking, eBooks, and ecommerce.

The requirements imposed by the Directive are of general character and based on functionality. They define the features of the products and services that need to be accessible but do not provide technical requirements. What technical solutions are applied to solve functional requirements is left to the economic operators. This approach allows for innovation and remains open to the identification of harmonized

standards which can be voluntarily complied with by industry entities. Member states are required to adopt and implement the Accessibility Act within six years after its entry to force, and is expected to reduce the costs for companies and member states by about 50% in total from removing and preventing current and future fragmentation in standards. By bringing people with disabilities to education and jobs, and extending the working lives of the older adults, the proposal is expected to reduce financial pressure on pensions and public budgets.

Transport Styrelsen released a report in August of 2014 on Automated Driving. It details the status of automated vehicles in Sweden, covering current legislation on automated vehicles, further being broken down by traffic regulation, vehicle legislation, driver competence, driver responsibility, and levels of automation. It concludes with issues for the Swedish Transport Agency to pursue moving forward. Among the points of note in this report are that the Swedish Road Traffic Ordinance as it currently exists does not present an obstacle to the test operation of automated vehicles, and vehicles which fail to meet technical requirements of the Swedish Transport Agency may be granted exceptions under some circumstances. Regulations on how new vehicles should operate and be designed have been harmonized within the EU through Framework Directive 2007/46/EC, but there are currently no regulations guaranteeing an identified level of safety for automated vehicles. There are currently no requirements to adjust the driving test or vehicle requirements for the driving test for automated vehicles. The Swedish Transport Agency may monitor developments and make changes to this policy as automated vehicles enter the market. And finally the working group believes there is no legislation to prevent the use of automated vehicles, as current road traffic legislation is based on driver responsibility for driving vehicles. As long as there is someone who can be considered to be a driver in or in connection with the vehicle, self-driving vehicles up to level 3 can be operated. The division and concept of liability will need to be further developed for level 4 vehicles, where no driver may be present. For the purposes of this report, level 1-2 vehicles include vehicles with self-driving functions which support the driver but for whom the driver is still liable for any violations of road traffic rules. The report recommends that the Swedish Transport Agency increase its knowledge base by participating in or cooperating with relevant testing regimes that are studying the development of automated vehicles, and to identify domestic and international groups which will increase the STA's ability to influence future developments in automated vehicle licensing and operation.

The Citymobil2 program is a pilot program funded by the EU and focused on testing the implementation of automated road transport systems. The vehicles used in these automated transport systems operate without a driver and provide transportation services in areas with low or dispersed demand outside of the main public transportation network.⁶⁹ The program was started in September of 2012 and will terminate in 2016, after three large scale demonstrations, four small-scale demonstrations, and three showcases.⁷⁰ The three large demonstrations were held in St. Sulpice, La Rochelle, and Trikala. Under the management of Adriano Alessandrini, the CityMobil2 program is expected to improve the understanding of how automated vehicles interact with road users, and will provide Guidelines and a legal framework for the design and implementation of automated transport systems as a result of the project.

⁶⁹ <http://www.citymobil2.eu/en/About-CityMobil2/Overview/>, accessed January 1, 2016

⁷⁰ <http://www.citymobil2.eu/en/City-activities/Overview/>, accessed January 1, 2016

2.3.3 Domestic Regulations, US Laws and Statutes

The most notable domestic regulations within the US have been primarily based on federal authority, mandating requirements for meeting the accessibility needs of people with disabilities in new constructions and renovations of existing facilities, and also provide some funding with associated compliance requirements.

2.3.3.1 2010 ADA Standards for Accessible Design

The ADA Standards for Accessible Design apply to State and local government facilities, public accommodations, and commercial facilities that are readily accessible and usable by individuals with disabilities. The requirements of the ADA Standards for Accessible design are intended for new constructions or altered facilities, and most recently updated on September 15, 2010. Existing facilities are generally permitted to remain unchanged from pre-existing accessibility standards even with minor changes or repairs, but new constructions or renovations must be brought into compliance with the Standards. Of course, since the Act is more than twenty years old now, many previously grandfathered facilities now fall under the requirements of the Standards due to renovation, where they have not been demolished entirely for new construction. Notably, the ADA Standards states that there comes a point where the sum total of alterations made to a room or facility would result in a consideration that a space were to functionally be wholly changed, whereupon the entire affected space must be made accessible. Changes to functional areas of a facility will trigger a requirement to make areas along the functional path of a facility accessible to individuals with disabilities. Such areas connected to functional areas include bathrooms, circulation areas, telephones, and drinking fountains. Relevant to transportation for persons with disabilities, the ADA Standards for Accessible Design cover Passenger Loading Zones and Bus Stops. Any medical care and long term care facilities where patients can stay for more than 24 hours must provide at least one accessible loading zone at an accessible entrance. Passenger Loading Zones located in facilities such as airports and bus terminals must also provide an accessible loading zone in every 100 linear feet of loading zone space, and provides technical requirements for accessibility and loading spaces

2.3.3.2 Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way (PROWAG)

The Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right of Way is a document issued by the US Access Board, and covers proposed guidelines for the design, construction, and alteration of pedestrian facilities such as sidewalks, street crossings, signaling, and other pedestrian circulation rights of way. Areas covered by the PROWAG are split into scoping and technical requirements, which apply to both permanent and temporary constructed facilities, altered portions of existing facilities, and elements added to existing facilities for pedestrian circulation and use located in the public right-of-way. Scoping requirements describe what is covered by the PROWAG. For example, Chapter R211 describes and defines Signage as “Signs that provide directions, warnings, or other information for pedestrians only and signs that identify routes served by transit stops.” Chapter R213 describes Transit Stops and Transit Shelters, R215 describes Passenger Loading Zones. Technical requirements define the design criteria elements that spaces and facilities must comply with to be considered accessible. For example R304 covers Curb Ramps and Blended Transitions and prescribes the appropriate grade and orientation of a curb ramp, as well as other elements such as the appropriate width of a ramp and clear space. Subsequent sections of the PROWAG technical requirements cover

Detectable Warning Surfaces, Pedestrian Street Crossings, and Accessible Pedestrian Signaling and Pushbuttons. Pedestrian accessibility is required to the extent practicable within the scope of the project, but compliance is not required if the pedestrian circulation path is not altered. Areas which are non-compliant must be placed on the entity's ADA transition plan and addressed at a future, specified date, and on a prioritized schedule of corrections. The Access Board issued the PROWAG as part of its duties in complying with or enforcing Chapter 504 of the Rehabilitation Act and the Architectural Barriers Act.

Chapter 504 of the Rehabilitation Act prohibits discrimination against individuals with disabilities under any program or activity receiving federal financial assistance. Under Chapter 504, the Department of Transportation provides federal financial assistance to state and local governments for the development of transportation networks, including pedestrian facilities in the public right-of-way.

The Architectural Barriers Act requires certain facilities financed with federal funding to be accessible to individuals with disabilities, covering facilities financed in whole or part by a federal grant or loan, where the federal agency providing the funding is authorized to issue standards for the design, construction, or alteration of the facilities.

2.3.3.3 The 21st Century Communications and Video Accessibility Act (CVAA)

The CVAA was signed into law on October 8, 2010 to update federal communications law to increase the access of persons with disabilities to modern communications. The update ensures the law's applicability with up-to-date technologies, including new digital, broadband, and mobile innovations. For example, text messaging, e-mail, instant messaging, and video communications are all covered by the new law.

Directly in relation to technology users, the CVAA requires access to web browsers on mobile devices by people who are blind or visually impaired, applies the hearing aid compatibility mandates to telephone-like equipment used with advanced communications services, and requires closed captions and/or video descriptions on mobile devices, to name a few.

The FCC has published and been constantly updating rules based on the CVAA to keep up with the rapidly advancing ICTs.

2.3.3.4 The Assistive Technology Act of 1998

The Act was passed by Congress to increase access to, availability of, and funding for assistive technology through state and national efforts. The act provided grants to stations for assistive technology, the protection and advocacy services related to assistive technology, and other national activities. As part of their findings of fact, Congress determined that over 54 million individuals in the United States had disabilities, and that disabilities "in no way diminish[es] the right of individuals to live independently, enjoy self-determination and make choices, benefit from an education, pursue meaningful careers, and enjoy full inclusion and integration in the economic, political, social, cultural, and education mainstream of society in the United States." The Assistive Technology Act of 1998 was amended in 2004, authorizing it for another six years and continued to provide States with financial assistance to support programs to "maximize the ability of individuals with disabilities and their family members et al. to obtain assistive technology devices and assistive technology services." At least 60 percent of a State's ATA funding must be used to support activities involving device demonstrations, loan and reutilization, and financing programs, with the remainder permitted to be used for spreading general awareness as well as training for the use, implementation, and integration for disability activities. A minimum of 5 percent must be used

for transition assistance to individuals with disabilities. However, the funding under the ATA cannot be directly used to purchase assistive technology devices for individuals with disabilities, and the funds received through the ATA must be guaranteed to be supplement, not replace funding from other sources for assistive technology.

The ATA of 1998 requires states to comply with **Chapter 508 of the Rehabilitation Act of 1973** as a condition of receiving assistance under the ATA. The Rehabilitation Act prohibits discrimination on the basis of disability in programs run by federal agencies, that receive federal financial assistance, and in the employment practices of federal contractors. Chapter 508 of the Rehabilitation Act requires that federal electronic and information technology be accessible to people with disabilities, including employees and members of the public. The Act defines an accessible information technology system as one which can be operated “in a variety of ways and does not rely on a single sense or ability of the user.” Chapter 508 covers technical standards for a number of categories, including software applications, web based intra- and internet based information and application, telecommunications, video and multimedia, self-contained products, and desktop and portable computers. Functionally, the Chapter requires a number of functional performance criteria be met, in particular, providing modes of operation and information retrieval that do not require user vision, high visual acuity, auditory capacity, user speech, and fine motor control. Chapter 508 standards were issued by the Access Board in 2000, and a new proposed rule was issued on February 18, 2015.

The Technology Law and Policy Clinic based at the University of Washington School of Law compiled a report on Automated Vehicle Laws and Recommendations for the Uniform Law Commission. It studies the current state of Automated Vehicle Laws among five US States and jurisdictions, analyzes these provisions, and makes recommendations on the development or improvement of subsequent regulations. Automated Vehicles are currently defined as in four states, Nevada, California, Florida, and Michigan, as being vehicles have technology which allows the vehicle to operate without “the active control or monitoring of a human operator.” This language is functionally consistent amongst the four States cited, with minor language variances. Despite this, the report recommends that “any duration of time” be added to the statutory language, reflecting concerns that some automated functions are more assistive (such as Level 2 lane-centering or speed control mechanisms) than complete (as in Level 4 automated vehicles). While not specifically focused on the status of people with disabilities, this does demonstrate the range of potential functions which make automated vehicles potentially useful for people with disabilities. A person with limited disabilities that make smoothly controlling a vehicle may benefit from combined function technologies that stabilize the driver's control of the vehicle during normal operation, while a person with visual or severe disability may be able to rely on a fully automated vehicle to transit from one location to another without making any control decisions during the trip itself.

2.3.4 Privacy

Privacy topics apply broadly when speaking of the development and deployment of technological solutions for persons with disabilities. Apps for smartphones collect location data which, when correlated with other data points, can be used in some cases to determine the rough identity of an individual. Automated vehicles, depending on their complexity and role, would be expected to communicate on a regular basis with mapping and wayfinding services, local infrastructure, other vehicles, and even the smart devices being used by surrounding pedestrians. However, as noted in an interview with the US

Access Board,⁷¹ the information of individuals with disabilities is not in and of itself of a type which would merit extraordinary protections. Rather, on a systemic level, it is merely one more piece of information which should be protected with the same vigor and attentiveness as any other piece of personally identifying information. Attorneys⁷² and privacy officers⁷³ of the FHWA noted that it is easiest if the government never collects data, while also acknowledging that the private sector collects vastly more data, particularly with mechanisms such as “Opt-in/out” clauses. Many private organizations adopt federal regulations and there are some questions of who controls if the private sector adopts technology and federal standards. As such privacy seems to be viewed by stakeholders on both sides of the issue as something that is extremely important, and yet individuals with disabilities merit no greater protection than those without. This can present a possible policy issue for the ATTRI program, in determining exactly what additional information is required for individuals with disabilities to gain service, and how to integrate that into the existing privacy regime.

The **Health Insurance Portability and Accountability Act (HIPAA)**, was enacted in 1996 and was broadly intended to combat waste, fraud, and abuse in health insurance and health care delivery, as well as improve access and administration of health insurance and health care services.⁷⁴ ⁷⁵ The portion of HIPAA which is most relevant to the privacy issues raised by the operation of assistive technology is the Privacy Rule under Title II of the Act. ⁷⁶ The Privacy Rule establishes national standards to protect the medical records of individuals and other personal health information and applies to, among others, health care providers that conduct certain health care transactions electronically, as well as the business associates who facilitate services that involve the use or disclosure of personally identifiable health information. The Rule requires safeguards to protect the privacy of personal health information, and sets limits and conditions on the uses and disclosures that may be made of such information without patient authorization. The information which is covered includes demographic data which could be used to identify an individual, which relates to the individual’s past, present, or future physical or mental condition, any health care that the individual receives, and the payment an individual tenders for such health care. The basic principle of the Privacy rule is that a covered entity may not use or disclose protected health information except as permitted or required by the Privacy Rule, or as the individual or the individual’s representative authorizes in writing.

The **Federal Privacy Act of 1974** establishes a code of fair information practices that governs the collection, maintenance, use, and dissemination of information about individuals that is maintained under the control of federal agencies.⁷⁷ The Privacy Act prohibits the disclosure of records about an individual from these systems without the written authorization of the individual, except fewer than twelve statutory exceptions, and also defines record keeping requirements for federal agencies.⁷⁸ ⁷⁹ These twelve statutory exceptions include routine uses within the agency, for statistical research, at the request of law

⁷¹ Based on results from stakeholder interviews.

⁷² Based on results from stakeholder interviews.

⁷³ Based on results from stakeholder interviews.

⁷⁴ <https://www.gpo.gov/fdsys/pkg/PLAW-104publ191/html/PLAW-104publ191.htm>, accessed January 1, 2016

⁷⁵ <http://www.hhs.gov/hipaa/>, accessed January 1, 2016

⁷⁶ <http://www.hhs.gov/hipaa/for-professionals/privacy/laws-regulations/index.html>, accessed January 1, 2016

⁷⁷ This requirement does not extend to information held by non-agency institutions such as the Courts and Nongovernmental Agencies.

⁷⁸ <http://www.justice.gov/opcl/privacy-act-1974>, accessed January 1, 2016

⁷⁹ <http://www.justice.gov/opcl/overview-privacy-act-1974-2015-edition>, accessed January 1, 2016

enforcement, for the health and safety of an individual, and at the order of a court or pursuant to a required FOIA disclosure. Agencies are required to have a Data Integrity Board in place to audit any violations of the Act. In addition, the requirements of the Privacy Act only apply to information held by Agencies themselves.

The next section expands on the privacy issues and concepts introduced in this section, and provides a deeper analysis of the privacy considerations ATTRI should apply to the program.

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Chapter 3. Personally Identifiable Information (PII) Privacy and Governance Issues

ATTRI focuses on research of development and implementation solutions for transformative technologies and systems, with the goal of improving the mobility of travelers with disabilities through the use of ITS and other advanced technologies. These transportation solutions have the opportunity to allow newfound mobility to ATTRI stakeholders and, in order to best serve this population, these solutions must not unduly compromise the privacy of their personal information. As such, the security and privacy of the personal information that accessible transportation technology companies and institutions collect is of the utmost importance.

Inherent in accessible transportation technologies are the privacy issues facing all technologies: how to protect and control the information provided by users and keep information out of the hands of those that intend to misuse it. Accessible transportation technologies have the potential to open worlds of access to people with disabilities; however, the data collected to allow the technologies to work can also lead to unintended consequences, such as a loss of privacy, data breach, and lack of use of the assistive technologies. Regardless of the technology in question, the considerations always come down to what information is collected, how it is maintained, how it is shared, and whether the individual has proper control over the updates to the data and notification of its use. It has been postured that as the severity of an individual's disability increases, there is an increase in the willingness to sacrifice privacy for functionality.⁸⁰ However, persons with disabilities should not have to make unnecessary sacrifice of privacy to benefit from advanced technologies. There are laws and technologies that will protect this population and their personal information.

This study explored the privacy framework in the United States; laws impacting the public and private sector, sector-specific information, states, and international privacy; applications of these frameworks and legal landscapes to emerging accessible transportation technology; and public expectations surrounding privacy in accessible transportation technology. The research shows that privacy can be a balancing act between using and protecting information, but making sure that information is collected, used, and shared securely is the key to ensuring that the benefits of information use do not compromise privacy rights.

Accessible transportation technology stakeholders can ensure that these protections are built into systems by considering the Fair Information Practice Principles (FIPPs) from day one of the planning process. These accessible transportation technologies are constantly changing and advancing and, at the

⁸⁰ Scott Beach, Richard Schulz, Julie Downs, Judith Matthews, Bruce Barron & Katherine Seelman, *Disability, Age, and Informational Privacy Attitudes in Quality of Life Technology Applications: Results from a National Web Survey*, TRANSACTIONS ON ACCESSIBLE COMPUTING (TACCESS), SPECIAL ISSUE ON AGING AND INFORMATION TECHNOLOGIES, vol. 2(1) (2009).

end of the day, ATTRI stakeholders will only use technologies that they feel they can trust, so ensuring that information is protected is both best for the public and for the institution designing and implementing transportation technologies. For the most part, ATTRI may not be actively engaged in ensuring that privacy protections are input into and upheld by accessible transportation technologies. However, ATTRI will need to identify where there are gaps in privacy and data protection and step in as participants to ensure that stakeholders' rights are upheld.

Appendix C. Personal Identifiable Information (PII) Privacy and Governance Issues a more in-depth summary of the research on the policy and legal framework of privacy as related to ATTRI technologies. Based on the research, below are our high level recommendations:

Privacy considerations must be at the forefront as ATTRI continues to build out its solutions for transformative technologies and systems. This study has provided in-depth analysis on requirements and best practices that impact ATTRI stakeholders. To that end, below is a summary of our high level recommendations:

- Build privacy solutions into a product or system design starting from Day 1, including adherence to the FIPPs, by leveraging functional reviews by a privacy expert. Dedicating a resource to reviewing privacy implications throughout design, development, execution, and interoperability with other systems or products would help maintain continuity and would allow for regular and consistent assessments of privacy impacts to users. Providing this type of dedication to user privacy will contribute to the users' confidence in ATTRI and help increase usage of ATTRI products.
- Adhere to all applicable laws – federal, state, and local – when designing accessible transportation solutions. This may mean not just following the letter of the law, but the spirit as well.
- Implement proper security controls when receiving data from, and sending data to, third parties. Data received from third parties should inherit the third party's security controls and be protected at a level commensurate with the level at which it was protected by the third party. When data is transferred, proper security controls should be written into contracts to ensure that the data remains protected and free from privacy breach. Additionally, all data in transit should be properly encrypted.
- Develop an ATTRI privacy policy that addresses minimum standards for privacy management. This should be applied to those handling PII, those developing systems with privacy implications, and those who are discarding PII, at a minimum.
- Familiarize yourself and your team with privacy issues and laws surrounding emerging technology, such as those discussed in Chapter C.5 in Appendix C. These cutting edge issues provide insight into consumer expectations of privacy as well as the potential for future regulations in analogous technology areas. This will also allow the team to understand when to raise questions about the privacy implications of products and engage the appropriate subject matter experts to evaluate any possible concerns, thereby eliminating costly redesign expenditures.
- Assess new and emerging privacy requirements annually and update ATTRI's privacy policy if necessary.

Chapter 4. Identification and Evaluation of Potential Actions

The analysis of policy, institutional, and legal issues reveals the existing barriers for development and deployment of ATTRI technologies. To address those issues, the project team identified a list of potential actions that could be sponsored or advocated by the ATTRI program. The potential actions were then evaluated based on their travel impacts, economic impacts, and implementation feasibility and prioritized according to the evaluation results. The identification and evaluation of potential actions are intended as starting points for fuller exploration of the potential actions ATTRI could take, and for more refined programs that could evolve into specific policy or rulemaking initiatives.

Chapter 4.1 identifies potential ATTRI actions based upon the policy issues, and the institutional factors that impact those issues in impeding the development and deployment of advanced technologies accessible to persons with disabilities, older persons, and veterans with disabilities. The paper identifies a set of eight viable actions (grouped in categories) for mitigating these issues. The actions are broadly conceived; substantial additional planning and refinement to formulate more precise actions will be necessary to provide a more complete basis for decision. It is to be anticipated that the set of actions will evolve but the assessment of these eight actions will be useful in driving that evolution and refinement.

Chapter 4.2 sets out criteria to be used in assessing and evaluating the priority of the candidate actions. Each criterion is described and the assessment of each action is presented in a tabular format. The criteria rely on accurate published survey data regarding the amount of travel performed by persons with disabilities relative to the general public, a subjective estimate of the effect of each action on the amount of travel, an economic evaluation of the potential increased travel, along with qualitative feasibility criteria.

Finally in Chapter 4.3, the potential action items are assessed and prioritized using all the criteria laid out in Chapter 4.2. Assessment of actions across the set of criteria results in a summary recommendation regarding the actions' priority relative to each other. Actions to promote disability needs awareness and the use of universal design (including its accessibility features) may significantly increase the number of trips traveled by persons with disabilities and the general population with significant associated economic value. Additionally, providing guidance on the liability of technology developers and providers could rank high among the potential actions.

4.1 Identification of Actions

Throughout the analysis of identified policy, institutional, and legal issues, a preliminary list of twenty potential actions were proposed. A workshop was conducted with USDOT staff and the research team on September 29, 2016 to screen the preliminary list. Eight actions were selected for evaluation. Table 2 presents the preliminary list of proposed potential actions and the policy, institutional, and legal issues they address. The eight selected actions are shown in bold font.

Table 2. Preliminary List of Proposed Potential Actions with Eight Selected Actions in Bold Font

#	Action Category	Institutional and Policy Issue	Action Item
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for infrastructure installation
3	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • o first-mile and last-mile mobility solutions
4	Funding	Affordability of emerging products/services	Provide user subsidies, e.g. subsidized TNCs, smartphones, and other technologies underutilized due to affordability challenges
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Provide guidance on liability and indemnification issues
6	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Potential limitation of liabilities for incubator enterprises
7	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Potential limitation on utilization of ATTRI related development efforts in tort litigation
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Enforce existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation
9	Awareness of Disability Needs	Lack of market incentives for development and implementation of accessible technologies	Leverage the broader market to provide commercial incentive for technology deployment that benefits people with disabilities
10	Awareness of Disability Needs	Potential of intermediate automation levels to address accessibility needs	Encourage exploration of intermediate automation levels as accessibility solutions and incorporation of accessible input/output mechanism to interact with vehicles

#	Action Category	Institutional and Policy Issue	Action Item
11	Awareness of Technologies and Resources	Travelers with disabilities lack awareness of available technologies and funding	Enhance technology and funding awareness among travelers with disabilities
12	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for data, maps, digital infrastructure inventory of indoor spaces (restroom, elevators, etc.) collection and maintenance requirements
13	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for purchase of equipment, e.g. autonomous personal vehicles or shuttles
14	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for operations and maintenance and training and coordination of systems and programs
15	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for training elderly and disabled persons to use personal handheld devices
16	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for using universal design to enhance accessibility within other services and products
17	Technology Risks	Personally identifiable information; breach of privacy concerns over emerging technologies and services	Provide guidance and clarification to private developers regarding privacy solutions in product or system design
18	Legal or Regulatory	Inconsistency of laws at the local, state, and federal levels	Reform and make consistent regulatory regimes at the state and federal level
19	Legal or Regulatory	Seniors and persons with disabilities are more vulnerable to cyber threats	Adopt legislation to provide additional protection for people with disabilities and older adults from cyber security threats, malware, and scams
20	Change in Institutions and Policies	Potential of TNCs in addressing accessibility needs of persons with disabilities not fully explored	Understand and capitalize the potential of Transportation Network Companies (TNCs) in accessible transportation, e.g. by integrating TNCs in the institutional and regulatory environment of accessible transportation (consider if it's done at other parts of DOT)

Source: AECOM

Many of these eight potential actions are characterized in very broad terms (“Enhance disability needs awareness,” “Emphasize existing regulations to eliminate barriers in the public right-of-way”). This research was too limited to proceed to compare alternative specific starting initiatives, although a few examples are discussed. A potential next step will be to analyze alternatives and prepare a more specific program to implement these actions. Three actions were grouped into the funding category, and another three in the technology risks category. Each action was associated with the policy, institutional, legal or privacy issues which it was intended to mitigate, and examples of the technologies that might benefit from the mitigation were selected. The range and nature of the actions identified and prioritized are representative of all advantageous actions, but the precise variations are not critical, as the formulations can be modified without major changes in the assessment. Current and past ATTRI activities may be linked to the identified actions suggested in this paper (for example, ATTRI’s research on travel needs of people with disabilities⁸¹). It is worth pointing out that the impact assessment of the potential actions in this paper took into consideration ATTRI’s research. Each action is then described with more specificity in the remainder of this section.

4.1.1 Action #1: Enhance Awareness of Disabilities Needs

The needs of people with disabilities are often neglected in product design and service delivery. With 12.6% of total US population having one or more disabilities⁸², the market is significant. The failure to address these needs is partly due to lack of awareness of disability needs. The universal design methodology is an existing effort to address disability needs in product design. It is intended to create products accessible to more persons, including people with disabilities and older adults. This methodology would make products and services available to a broader clientele.

One potential action proposed is to enhance awareness of disability needs and universal design methodology among private enterprises and policy makers by engaging the community of people with disabilities and the technology community. ATTRI has already made efforts in this regard. In May 2016, ATTRI published “User Needs Assessment: Stakeholder Engagement Report” that documents the travel needs of people with disabilities. To promote the findings documented in this report and further enhance awareness, ATTRI should evaluate the most cost effective ways to serve its mission by enhancing awareness of inclusive and universal design, and of otherwise raising awareness in the transportation technology stream of the needs of users with disabilities. ATTRI could undertake a program of awareness campaigns, which would require ATTRI to seek funding from existing programs or advocate new funding for such activities.

Another possible approach to enhance awareness of disability needs is to facilitate a certification program for product and service accessibility. The program should provide a system of certification that verifies and/or rates a product’s or service’s accessibility features based on established standards, e.g. ADA standards. A program like this, coupled with nation and industry wide recognition, would effectively enhance awareness of disability needs among product designers and service providers. It also would help consumers with disabilities to make informed selection of products and services. Analogous examples of certification programs include Underwriters Laboratories, which certifies product safety, the Non-GMO Project, which certifies non-GMO (genetically modified organism) food products, and U.S. Green Building Council, which certifies energy efficient and environmentally friendly building designs.

⁸¹ Accessible Transportation Technologies Research Initiative (ATTRI), 2016, *User Needs Assessment: Stakeholder Engagement Report*, May. http://www.its.dot.gov/research_archives/attri/pdf/REV_508_ATTRI%20Final%20Report.pdf

⁸² U.S. Census, 2014 American Community Survey, <http://www.census.gov/programs-surveys/acs/news/data-releases/2014/release.html>

Advanced analyses are needed to determine what entity is most suitable for owning and developing the program, how the certification should be designed, and what role ATTRI should play in developing and promoting the program.

4.1.2 Action #2: Provide Funding for Enabling Technology Development and Deployment

Deployment of new technologies may require upgrading or installing new facilities in the public domain, for example, sensors in public right-of-way and transit stations for short range communication with wearable devices, or lane marking for autonomous vehicles. In some cases, infrastructure can be such a huge investment that is not financially feasible for private enterprises partners to take on. However, the economic and social benefits of deploying such technologies may well justify the investment in infrastructure. Providing public funding for such investment can fill the gap in the existing capacity to do so.

Funding for technology deployment may be available through some existing programs, e.g. Surface Transportation Program. ATTRI could identify such sources of potential funding, coordinate with other agencies (e.g. Department of Health and Human Services) that would benefit from the infrastructure to secure funds from those sources, and advocate for new funding program to meet infrastructure needs. The effect of this action would rely heavily on the Congress and state legislatures.

4.1.3 Action #3: Provide Funding for Pilot Studies

Providing funding for pilot studies is another way to assist market deployment of technologies. Its primary impact would be the deployment of any specific technologies which reached commercialization. The analysis and selection of such technologies was not the subject of this research. However, a secondary impact of this action could be in overcoming institutional, policy and legal barriers such as those listed above, and thereby showing the way to reduce those barriers to other efforts. This action could target the readily available technologies, such as in-station Bluetooth-based navigation systems and augmented reality wayfinding, transit and wayfinding apps with static and real-time transit data, information and communication technologies (ICT) to aid in paratransit use, and first- and last-mile mobility solutions. Pilot studies will determine the economic feasibility of deploying such technologies and/or products for persons with disabilities and explore business models, market potential, and marketing strategy for technology developers who may otherwise choose not to enter the market due to possibly false perception of small market potential and lack of economic feasibility. Action #4: Provide User Subsidies

Technology developers and private companies found that lack of access to smartphones and other wearable devices is a major barrier for people with disabilities to benefit from technologies, like wayfinding applications. Among people with disabilities, unemployment rates and poverty rates are higher than among people without disabilities. In addition, living with disabilities inevitably incurs higher medical and living expenses. Providing user subsidies would encourage more people with disabilities to access wearable devices. To ensure the subsidy is used to purchase wearable devices, ATTRI could consider in-kind subsidies for people with disabilities, i.e. providing assistive devices instead of monetary subsidies for people with disabilities. Similarly, user subsidies for other products and services, such as Transportation Network Companies' (TNC) services, would encourage market deployment of related technologies as well. ATTRI should also consider training subsidy recipients to use the technologies.

The federal program, LifeLine, provides smartphones and data plans at a discounted cost to low-income residents who meet income eligibility requirements. ATTRI could expand benefits from existing subsidy

sources to people with disabilities by gathering support to secure funding from those sources. ATTRI could also seek additional subsidies to expand eligibility and could focus the subsidies on smartphones that meet accessibility criteria.

4.1.4 Action #5: Provide Guidance on Liability and Indemnification Issues

The potential risks of liabilities associated with technology deployment for people with disabilities can be perceived as significant and can be inhibiting. People with disabilities may be perceived as more vulnerable to hazards on the road. The variety of disabilities and the mobility needs makes it more difficult to contain the potential risks of technologies targeting people with disabilities. The burdens that general consumer protection standards put on technology developers may be too restrictive for some technology developers to deploy. It is proposed that ATTRI provides them guidance on liability and indemnification issues. The guidance can specifically address risks and liabilities among potential users with disabilities. Nonetheless, the guidance should not be regarded as a substitute for professional legal advice. The guidance should advise technology developers to hire specialized attorneys as needed to provide tailored solutions.

4.1.5 Action #6: Potential Limitation of Liabilities for New Business Ventures

For new business ventures, which are most vulnerable to liability claims, limiting their exposure to liabilities would help these enterprises sustain and grow in the very initial phase of establishment. Limiting liabilities for start-ups which meet criteria defined according to the ATTRI mission requires legislative actions from the Congress and/or state legislatures. ATTRI can play an advocacy role in advancing the awareness among legislators of such needs and broader benefits to people with disabilities.

4.1.6 Action #7: Potential Limitation on Utilization of ATTRI Related Development Efforts in Tort Litigation

One last step that could reduce perceived risks in development and deployment of technology would be to prohibit or limit the use of accessible design, and accessible deployment efforts in tort (including negligence) litigation against technology developers and technology providers. This could be accomplished through some combination of federal and state legislation. While a technology firm would remain liable for negligence, that negligence would have to be established without using as evidence the firm's specific efforts to make its technology accessible to persons with disabilities. Many questions remain as to precisely how and on what terms such a limitation could be enacted, but there are analogous protections, e.g. for efforts to make a product or service safe to use, which could provide guidance. Technology developers should seek professional legal advice as needed from specialized attorneys.

4.1.7 Action #8: Emphasize Existing Regulations to Eliminate Barriers in Public Right-of-Way

Barriers in public rights-of-way, for example broken pedestrian sidewalks, missing curb cuts, textured sidewalk surface, for people with low vision, hinder people's ability to access almost all modes of transportation. They also reduce the utility of many advanced technologies that could have overcome some mobility challenges for people with disabilities. For example, wayfinding applications for pedestrians with disabilities would be less useful where the pedestrian infrastructure is poorly designed and maintained.

Public right-of-way is generally a responsibility of the state and local governments. There are federal, state, and local regulations that set minimum accessibility requirements for people with disabilities. A potential action for ATTRI is to emphasize the existing regulations to the public right-of-way owner governments and to raise awareness of the benefits of such regulations by deploying advanced technologies among the enforcement agencies. ATTRI could achieve that by promoting the free ADA training offered by the FHWA Resource Center for federal, state, local government employees and private individuals.⁸³

When considering the proposed actions, ATTRI and other potential action owners should be aware that a January 30, 2017 executive order requires executive departments and agencies to manage regulatory activity in a specific manner. The new requirement may increase the difficulty of a proposed action if it involves issuing new regulations. Implementation of Actions #4, #6, #7, and #8 may be affected by this executive order.

4.2 Criteria for Prioritization of Actions

This prioritization section begins with a set of criteria for assessing impacts of potential action items. Three major areas of criteria are proposed:

- Travel impact in terms of number of additional trips as a result of a proposed action, including overall travel impact, and impact on each of the three ATTRI stakeholder groups, i.e. people with disabilities, veterans with disabilities, and older adults,
- Business and economic impact, in monetized value, and
- Feasibility of proposed actions, for example, timing, prerequisite resources and actions, and dependency on other stakeholders. The proposed actions will be ranked according to their feasibility.

There is some unavoidable overlap between the first two major areas of criteria in that both impact important secondary outcomes such as healthcare and employment. In the case of travel impact, most additional trips will be made for a work, consumption (service or retail), or healthcare purpose rather than for travel itself. Thus, an increase in trip making among the three ATTRI stakeholder groups reflects an increase in these important activities. As employment and healthcare outcomes improve, there are important business and economic impacts that include less reliance on social benefits, an expansion of the labor force, and greater worker productivity.

For each of the criteria above, this section describes the assessment methodology, provides relevant findings from prior research, summarizes data sources, and then presents the assessment for each of the eight action items. Assessment based on these criteria is summarized for all proposed actions and the actions have been prioritized based on a comprehensive review of the assessment results.

⁸³ The FHWA Resource Center offers training and expert assistance in a variety of transportation technical areas designed to meet the needs of FHWA Division offices, state Departments of Transportation, Metropolitan Planning Organizations, local agencies, as well as other customer segments throughout the United States. <https://www.fhwa.dot.gov/resourcecenter/>

4.2.1 Travel Impact

In terms of number of trips, this criterion addresses the degree to which mobility is expected to improve as a result of an action. While qualitative consideration could be given to various aspects of mobility such as access to transportation, affordability, identifiable unmet demand for transportation, as well as actual travel, experience suggests that an assessment of travel is one of the most objective and understandable summary measure. We address this primarily as the increase in the number of one-way person trips that could be expected from an ATTRI action. This impact metric considers mobility benefits for the entire population (which should not be neglected where an ATTRI action has this broad benefit), as well as proportion of mobility benefits attributable to the target ATTRI population differentiating which subset of actions will add the most value in the context of the broader accessible transportation environment. Sizes of the overall travel market and the travel markets of the three ATTRI stakeholder groups (people with disabilities, veterans with disabilities, and older adults) will be estimated separately in terms of number of trips, establishing the baseline. Mobility impacts of the proposed actions will be assessed in terms of increase in number of trips in the affected travel markets.

4.2.1.1 Market Sizes

We have estimated the market sizes of all travelers and people with disabilities.

(1) All Travelers

According to the 2009 National Household Travel Survey (NHTS), total population aged 5 and over in the United States was 283,054,000 and total annual person trips amounted to 392 billion.⁸⁴

(2) People with Disabilities

The 2009 NHTS survey asked whether the survey respondent has a medical condition or handicap, temporary or permanent, that makes it difficult to travel outside of the home. According to the 2009 NHTS survey results, about 10.3 percent of people aged 5 or over reported having a medical condition that limits their travel.⁸⁵ The size of this population group was about 29,154,562. We recognize that there may be different definitions of people with disabilities and hence different estimates of the size of this population group. For example, the U.S. Census estimated about 56.7 million people had a disability in 2010⁸⁶. This 2009 NHTS is an unusually powerful set of data regarding travel by persons with travel disadvantages; therefore, for the purpose of this paper, the group of people with travel restrictive medical conditions as termed in 2009 NHTS is regarded as people with disabilities.

4.2.1.2 Travel Impact on Persons with Disabilities

Review of previous studies concludes that major mobility constraints for persons with disabilities include (1) difficulty of walking due to poorly designed and/or maintained pedestrian environment, (2) difficulty in

⁸⁴ Santos *et al.* 2011, *Summary of Travel Trends: 2009 National Household Travel Survey*, Federal Highway Administration. <http://nhts.ornl.gov/2009/pub/stt.pdf>

⁸⁵ Mattson, J., 2012, *Travel Behavior and Mobility of Transportation-Disadvantaged Population: Evidence from the National Household Travel Survey*, Small Urban & Rural Transit Center, Upper Great Plains Transportation Institute, North Dakota State University. <http://www.ugpti.org/pubs/pdf/DP258.pdf>

⁸⁶ <https://www.census.gov/newsroom/releases/archives/miscellaneous/cb12-134.html>, accessed February 14, 2017.

using a personal vehicle, (3) difficulty in using public transit and paratransit, and (4) unaffordability of available transportation options. These studies are summarized below.

In the 1994 National Health Interview Survey on Disability⁸⁷, the most frequently cited problem for traveling was difficulty in walking, with over 75% of those who said that they had difficulties getting around reported walking problems. Whereas 13% reported low vision and 10% reported cognitive or mental disabilities. At the same time, the 2002 National Transportation Availability and Use Survey⁸⁸ shows that difficulty of walking is cited more frequently by persons with disabilities than difficulty using public transit and paratransit. Based on these findings, actions that improve pedestrian environment would likely benefit the majority of the population with disabilities. And because walking is necessary for the use of all other transportation modes, actions that reduce walking difficulty would improve the accessibility and user-friendliness of other modes as well.

The studies reviewed show that individuals with disabilities rely more heavily on personal vehicles than any other modes of transportation, such as buses, paratransit, or taxis. A study⁸⁹ summarizes, from the 2002 National Transportation Availability and Use Survey, transportation modes used by people with disabilities in the past month for local travel. Traveling by personal vehicle either as a driver or as a passenger significantly outweighs the other transportation modes among people with disabilities, with the exception of walking. See Table 3. However, compared to persons without disabilities, percentage of personal vehicle use among persons with disabilities as a driver is significantly lower (e.g. 68.6% of people with disabilities compared to 91.5% of people without disabilities between 25 and 64 years old). According to these studies, actions that reduce the barriers for persons with disabilities to use personal vehicles, especially as a driver, would have significant benefits for this group.

Table 3. Transportation Used for Local Travel

Travel Mode	% of People with Disabilities			% of People without Disabilities		
	< 25	25–64	65+	< 25	25–64	65+
Personal vehicle (driver)	49.1	68.6	55.6	74.7	91.5	88.8
Personal vehicle (passenger)	89.6	77.5	70.5	91.9	77.7	62.2
Carpool, vanpool	28.7	8.8	3.6	21.2	10.0	3.4
Public bus	20.9	12.8	5.8	13.8	12.2	7.6
ADA paratransit	3.7	5.3	7.2	0.4	2.3	2.9
Specialized services	2.6	4.0	2.9	0.2	3.6	3.3
Private or chartered bus	6.3	3.9	4.7	7.7	4.0	4.7
School bus	24.6	1.9	0.0	21.6	3.7	0.5
Subway/light rail/commuter rail	9.5	7.1	2.0	8.5	11.1	3.2
Taxicab	8.6	12.4	8.2	7.5	11.6	4.5

⁸⁷ National Center for Health Statistics, Centers for Disease Control, 1994. *National Health Interview Survey on Disability, Phase I and Phase II. Survey and Data Collection Systems: National Health Interview Survey on Disability (NHIS-D)*. http://www.cdc.gov/nchs/about/major/nhis_dis/nhisddes.htm

⁸⁸ U.S. Department of Transportation, Bureau of Transportation Statistics, 2003, *Freedom to Travel*. This is the source of all statistics from the 2002 National Transportation Availability and Use Survey, unless otherwise indicated. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/freedom_to_travel/index.html

⁸⁹ Sweeney, M. 2004, *Travel Patterns of Older Americans with Disabilities*, Working Paper 2004-001-OAS, Bureau of Transportation Statistics. http://www.rita.dot.gov/bts/sites/rita.dot.gov.bts/files/publications/bts_working_papers/2004/paper_01/index.html

Travel Mode	% of People with Disabilities			% of People without Disabilities		
	< 25	25–64	65+	< 25	25–64	65+
Electric wheelchair, scooter, golf cart	2.0	0.8	1.0	2.1	2.9	2.4
Bike	48.0	15.9	3.7	46.6	27.1	10.8
Walk	56.0	47.9	37.7	55.0	60.5	53.8
Other transportation	12.0	5.4	2.8	4.8	5.8	4.5

Source: 2002 National Transportation Availability and Use Survey.

Statistics from the 2002 National Transportation Availability and Use Survey also show that 12% of persons with disabilities have difficulty getting the transportation they need, compared to 3% of persons without disabilities. “No or limited public transportation” and “do not have a car” are cited by both persons with and without disabilities as the top two difficulties with transportation. Lack of available transportation is a constraint common to all individuals who have difficulties getting the transportation they need regardless of their disabilities. However, “disability makes transportation hard to use” and “no one to depend on” are the constraints almost unique to persons with disabilities. See Table . While 17% and 12% of persons with disabilities having difficulties getting needed transportation cited those two problems respectively, only 0.4% and 2% of those without disabilities cited them. Therefore actions to increase transportation availability would benefit all individuals who lack transportation options; whereas reducing or eliminating the difficulty or dependence to use transportation would benefit persons with disabilities.

Table 4. Difficulties Getting Needed Transportation for Persons with and without Disabilities

Problem Cited	% Persons with Disabilities with Difficulty Getting the Transportation They Need	% Persons without Disabilities with Difficulty Getting the Transportation They Need
No or limited public transportation	33%	47%
Do not have a car	26%	23%
Disability makes transportation hard to use	17%	0.4%
No one to depend on	12%	2%

Source: 2002 National Transportation Availability and Use Survey.

Affordability of available transportation options is yet another concern for persons with disabilities. According to the 2010 Census, only 41.1% of those age 21 to 64 with any disability were employed, compared with 79.1% of those with no disability. Among adults aged 21 to 64 with disabilities, the median monthly earnings was \$1,961 compared with \$2,724 among those without disabilities in 2010. Among people age 15 to 64 with severe disabilities, 10.8% experienced persistent poverty. Two earlier studies have concluded that transportation barriers among the elderly and those of any age with disabilities can be reduced by higher income.⁹⁰ With sufficient income, the mobility barriers in Table 4 can be eliminated or at least reduced. For example, with higher income, one without a car can afford to purchase one; one who cannot drive can depend on a care taker, use taxi, or install assistive technologies in his/her car; one who lives in a neighborhood with broken sidewalks could move to a new location with infrastructure more friendly to persons with disabilities. Actions that increase the affordability of technologies, either by

⁹⁰ U.S. Congressional Budget Office, 1979, *Urban Transportation for Handicapped People: Alternative Federal Approaches*. Washington, DC: Government Printing Office. U.S. Senate, Select Committee on Aging, 1970, *Older Americans and Transportation*. Washington, DC: Government Printing Office.

subsidizing users or by reducing costs, would likely have substantial impacts on the ability to travel among people with disabilities. These impacts are assessed in Chapter 4.3.1 and summarized in Table 5.

4.2.1.3 Travel Impact on All Travelers

Some ATTRI technologies may benefit not only the ATTRI stakeholder groups, but also have spillover effects on all travelers. Wayfinding and navigation solutions, and many ITS technologies are such examples that would benefit all travelers. The potential action items defined in this paper that promote the development and deployment of ITS would have positive travel impact for the general population. These impacts are assessed in Chapter 4.3.1 and summarized in Table 6.

4.2.2 Business and Economic Impact

The prior sections have introduced a variety of actions that ATTRI might undertake to accelerate the adoption of assistive technologies in the market. The following section considers the business case for each of the recommended action items. Data shows that the typical traveler without a disability makes 4.06 one-way trips per day on average. By contrast, the typical traveler with disabilities makes 2.60 one-way trips per day on average⁸⁵. This reduction in trip making implies lost productivity and less spending rippling through the economy. In this assessment, each individual action is projected to facilitate an additional increment of trip making by travelers with disabilities—partially closing the gap between the 2.60 and 4.06 one-way trip rates. The value of these additional trips that would not have been made but for the action reflects the additional productivity and spending enabled by the trip. Given the diversity of actions and beneficiaries, the evaluation takes a broad approach and estimates the gross benefits of the candidate action and the maximum cost that one would incur to facilitate that increment of trip-making.

Box 1. Partnering with the LifeLine Program could promote increased access to appropriate technology

Applications currently exist that can aid a person with a disability with communication and wayfinding – allowing for greater mobility. However, because of limited incomes, many persons with disabilities cannot afford the smartphones required to use the applications. Federal programs, such as the LifeLine Program, provide smartphones and data plans at a discounted cost to low-income residents who meet income eligibility requirements. While these programs can assist many within the population with disabilities, the extra costs linked to disabilities make smartphones unaffordable for those who make just above the eligibility requirements. In 2014, 22 percent of persons with disabilities between 21 and 64 years old was fully employed with median annual earnings of \$40,463 in 2006 dollars. Therefore, there are more than 2 million people than are above the 135 percent poverty line threshold by earning less than \$40,463 per year. Expanding the eligibility requirements for persons with disabilities would allow more people to participate in the program and obtain a smartphone and an affordable data plan. Increasing the availability of smartphones would allow for increased mobility for persons with disabilities and provide incentive for developers to create additional applications.

In addition, in order to provide detail on how the economic impacts would be generated, the business case discussion includes individual policy profiles describing how a particular market intervention or policy change would allow travelers with disabilities to more fully participate in the economy or save money. In particular, these profiles highlight that there are additional considerations beyond capturing the cost of a trip otherwise not taken. For example, Box 1 highlights an option to increase smartphone penetration among the population with disabilities increasing access to a variety of applications to facilitate navigation

and services (linked to Action #4, provide user subsidies). The Box 2 highlights how addressing technology risks is related to the potential savings to service providers, potential increase in service quality, and coordination challenges associated with combining private TNCs and publicly-provided services (associated with Action #5, provide guidance on liability and indemnification issues). Finally, the Box 3 highlights initiatives in the U.S. to certify products and services for certain accessibility features and a potential program to comprehensively certify product and service accessibility. Such a program, ideally one with nation and industry wide recognition, would be an effective way to enhance awareness of disability needs among private enterprises. At the same time, it helps consumers with disabilities make informed selection of products and services (associated with Action #1, enhance awareness of disability needs).

More details on the assumptions underpinning the economic analysis and the results are provided in Chapter 4.3.2.

Box 2. The challenge of combining Demand Response services and TNCs

With the rise of Transportation Network Companies (TNCs), there has been increased interest in using the services of these companies to support the efforts of paratransit programs. Support from TNCs could reduce the costs of the demand response program, while increasing service for the disable community. A one-year pilot program has recently started between TNCs and the Massachusetts Bay Transportation Authority (MBTA) - the program will cost less for riders (\$2 at the beginning of their trip and the rest of fare above \$15) and could save the MBTA \$10 million annually.

However, establishing partnerships between TNCs and paratransit programs has been hindered due to insurance and liability concerns. Reducing or eliminating these obstacles through legislation and/or providing a template of an acceptable agreement could increase the number of partnerships across the country and accelerate the pace in which these agreements are established.

4.2.3 Feasibility of Proposed Actions

Besides benefits, the priority of a potential action should also depend on its feasibility. Feasibility of the potential actions was assessed based on the following criteria:

- Timing of action
- Dependency on owner of the action
- Prerequisite issues
- Alignment with US Department of Transportation (DOT) and ATTRI priorities
- Alignment with the interests of USDOT Constituencies

4.2.3.1 Timing of Action

The potential actions were evaluated based on the timing of when they could be implemented. Actions that can be taken quickly will receive higher priority, but actions that could have the desired impact even if delayed will receive lower priority.

4.2.3.2 Dependency on Owner of the Action

The potential actions involve various entities in decision making and implementation. Some of the actions can be implemented by ATTRI alone or with agencies within USDOT. While others depend on parties beyond USDOT's influence, e.g. federal, state, local legislative bodies, executive offices and agencies, or private sector. Actions that can be implemented by ATTRI or USDOT alone will receive higher priority, while the more an action relies on other parties the lower its ranking.

Box 3. A product accessibility certification program could promote awareness of disability needs

A "disability accessible certification" program could assist the community of people with disabilities by identifying products and services that comply with ADA criteria, while also raising awareness of disability needs among companies and organizations. Today in the United States, there are isolated certified products but no uniform procedures or regulations on how to report that a product or service meets disability access requirements. A stamp or seal indicating certification would allow people with disabilities to easily identify products or services that meet ADA criteria. The program would also allow organizations and companies to promote a product or a service as being certified. In addition, the certification would raise awareness of the needs of people with disabilities to companies and product developers, who may be able to design or adapt their product to meet the needs. By providing a certification program with appropriate support, ATTRI could assist people with disabilities and raise awareness of disability needs among private enterprises.

4.2.3.3 Prerequisite Issues

Implementation of some potential actions is dependent on issues to be resolved beforehand, while other actions do not have such prerequisites. Those without prerequisites will be rated higher, and those with many and complex prerequisites will be rated lower.

4.2.3.4 Alignment with USDOT and ATTRI Priorities

The potential actions are evaluated by their levels of alignment with USDOT's and ATTRI's priorities. The strategic goals of the USDOT, according to its 2014-2018 Strategic Plan⁹¹, are

- Safety
- State of good repair
- Economic competitiveness
- Livable communities
- Environmental sustainability

⁹¹ U.S. Department of Transportation, *Transportation for a New Generation – Strategic Plan Fiscal Years 2014-2018*. https://www.transportation.gov/sites/dot.gov/files/docs/2014-2018-strategic-plan_0.pdf

The strategic themes of the Intelligent Transportation Systems Joint Program Office, as laid out in its 2015-2019 Strategic Plan⁹², are

- Enable safer vehicles and roadway
- Enhance mobility
- Limit environmental impacts
- Promote innovation
- Support transportation information system sharing

4.2.3.5 Alignment with the Interests of USDOT Constituencies

The potential actions are also evaluated based on their alignment with the interests of USDOT constituencies, e.g. technology users, private technology developers, state and local governments, and other stakeholders. Alignment with the interests of the constituencies would allow ATTRI to draw upon their political support, whereas misalignment would induce resistance.

The feasibility evaluation of the potential actions are in Chapter 4.3.3.

4.3 Actions Evaluation and Prioritization

The potential actions were evaluated for each of the criteria as set out in Chapter 4.2. Based on the evaluations across all criteria, the potential actions were assigned an overall priority rating. As pointed out in Chapter 4.1, the impact assessment of the potential actions took into consideration the impacts of current and past ATTRI activities.

4.3.1 Travel Impact

For each potential action, the degree to which mobility is expected to improve was estimated for different population groups:

- Persons with disabilities
- Older adults
- Veterans with disabilities
- All travelers

The estimation of impact was done in terms of number trips. We first estimated the impact of an action on the trip rate, or the average number of trips made per day, of a person within each population group. The impact on trip rate expressed in percentage would then be multiplied by the base trip rate, or the trip rate prior to implementation of any potential actions, which would then be multiplied by the market size (total population of the group), and by 365 for annualization. That would result in the total annual change in trips made by a population group. This calculation can be expressed by the Equation 1 below.

⁹² U.S. Department of Transportation, Intelligent Transportation Systems, Joint Program Office, 2014, *USDOT's Intelligent Transportation Systems Strategic Plan 2015-2019*. <http://www.its.dot.gov/strategicplan/>

Equation 1 Total Annual Change in Trips Made

$$= \text{Trip Rate Impact} \times \text{Base Trip Rate} \times \text{Market Size} \times 365 \text{ Days}$$

While there are other benefits of accessible transportation technologies, such as safety, convenience, reduced travel time and reduced cost, transportation planning experience suggests that the trip rate or total travel is the most objective indicator in the largest sense. If total travel is accurately estimated, it will reflect most of the other benefits through the decisions of individuals to travel.

4.3.1.1 Estimating the Impact on Persons with Disabilities Relative to General Public

The trip rate of population with travel restrictive medical conditions is approximately 2.60, compared to 4.06 for those without such medical conditions⁸⁵. That is a 56.3% difference in trip rate. The difference in trip rate may be largely explained by the inaccessibility of transportation, but may also be explained by other differences, particularly lack of employment or inaccessibility of potential trip attractions.

Theoretically, the trip rate impact of a potential action item on persons with disabilities could range from 0% to no more than 56.3%. An impact of 56.3% increase in trip rate implies the action could completely eliminate the mobility constraints unique to persons with disabilities as well as other differences, or in other words, persons with disabilities would have the same level of mobility as those without disabilities.

Based on the probative data found on mobility constraints and travel behaviors of persons with disabilities, and on estimates of technology impacts on travel in other contexts, the team assessed the proportion of the potential 56.3% increase that might arise from the respective ATTRI actions. Review of previous studies concludes that major mobility constraints for persons with disabilities include (1) difficulty of walking due to poorly designed and/or maintained pedestrian environment, (2) difficulty to use a personal vehicle, (3) difficulty to use public transit and paratransit, and (4) unaffordability of available transportation options. The actions items that would facilitate the removal or reduction of mobility barriers in the above areas were estimated to have higher positive impacts on trip rates.

Action #1, through enhancing awareness of disability needs and universal design methods among private enterprises and policy makers, is expected to stimulate private sector activities in accessibility technology development for all transportation modes. Action #8 would facilitate elimination of travel barriers in pedestrian sidewalk for people with disabilities. Since the sidewalk is an integral part of almost all trips, this action would benefit people with disabilities for almost all trips they would make. In addition, these two actions would benefit a wide range of ATTRI technologies, as the issues they address are widely present. Due to their broad and fundamental impacts, these two actions were estimated to have high impacts relative to the other actions.

Action #2 provides funding for enabling technology development and deployment. This action would greatly benefit the technologies that require large investment in new infrastructure for deployment. For example, beacons in public rights-of-way and transit stations for short range communication with wearable devices. However, technologies only relying on existing infrastructure would not be affected by this action. Compared to the actions above, the impact of Action #2 was estimated to be less prominent and ranked “medium”.

Action #4 is to provide user subsidies. This action directly addresses the unaffordability issue of ATTRI technologies among people with disabilities. Subsidies could be monetary or in kind. Both approaches have their advantages and limitations. If monetary subsidies are provided to eligible individuals, though it increases the recipients’ buying power, there is no guarantee that all the subsidies would be spent on ATTRI technologies. If the subsidies are provided in kind, for example to give out smartphones to eligible

individuals, only certain types of technologies may benefit from the program given the constraint of funding amount. Considering the action addresses one of the major mobility constraints, high costs of technologies, but with its potential limitations, we assigned the action a “medium” ranking of impact relative to the other actions.

Actions #5, 6, and 7 would help address the liability issue, a common barrier for private technology developers. The actions will benefit all ATTRI technologies and all transportation modes. However, the impact estimation for these actions is highly speculative. A “medium” ranking was assigned to the three actions due to the uncertainty, but given these three actions’ wide impacts on ATTRI technologies and transportation modes, we expect they would have slightly higher travel impacts than the other two “medium” actions, Actions #2 and #4.

Action #3 provides funding to pilot studies for small-market deployment of new technologies. The impact of this action was estimated to be low relative to the other seven actions, because each funded pilot study is only focused on one type of technology and it may only benefit a subset of ATTRI stakeholders. Whereas other actions, especially those estimated to have high impacts would benefit a broad range of technology developers and users.

The research team did a literature scan to find a reasonable range of potential trip rate impacts for the potential actions. A study by the Puget Sound Regional Council⁹³ estimated the trip rate impact of autonomous vehicles for all travelers in the Puget Sound region would be 4.88%. Since people with disabilities have less viable transportation alternatives than those without such disabilities, it is expected that the trip rate impact of autonomous vehicles for people with disabilities should be significantly higher than 4.88%. A separate study by researchers in Carnegie Mellon University⁹⁴ estimated that the impact of autonomous vehicles on vehicle miles travelled among non-drivers, elderly drivers, and drivers with travel-restrictive medical conditions would be a 14% increase. Impact on vehicle miles travelled is different from impact on trip rate – increase in vehicle miles travelled may be a result of longer trips instead of more trips; but it sheds some light on the magnitude of impact autonomous vehicles may have on the mobility of people with disabilities. However, the potential actions identified in this research are not expected to carry impacts nearly as significant as autonomous vehicles would. Therefore, we estimated the range of trip rate impact of the potential actions should be from 0% to 5%.

Actions #1 and 8 were estimated to have a trip rate impact of 5% increase. Actions #2 and 4 were estimated to have a trip rate impact of 2%. Actions #5, 6, and 7 were estimated to have a trip rate impact of 3%. Action #3 was estimated to have a trip rate impact of 0.5%. The estimated impacts on trip rate were applied to Equation 1 to estimate how many additional trips will be generated as a result of this action. The base trip rate is 2.60, i.e. the trip rate of population with travel restrictive medical conditions prior to implementation of any potential action. Table 5 summarizes the estimated trip rate impacts of the potential actions on people with disabilities. The table shows for each proposed action,

- its estimated impact on the average number of trips made by a person with disabilities on a day (expressed in percentage in the column “Trip Rate Impact”)

⁹³ Childress *et al.*, 2014, *Using an Activity-Based Model to Explore Possible Impacts of Automated Vehicles*, submitted for presentation at the 2015 Transportation Research Board Annual Meeting. <https://psrc.github.io/attachments/2014/TRB-2015-Automated-Vehicles-Rev2.pdf>.

⁹⁴ Harper *et al.*, 2016, *Estimating Potential Increases in Travel with Autonomous Vehicles for the Non-Driving, Elderly, and People with Travel-Restrictive Medical Conditions*, Transportation Research Part C: Emerging Technologies, 72, 1-9.

- current trip rate, before implementing the proposed action (in the column “Base Trip Rate”)
- total population with disabilities (in the column “Market Size”), and
- change in total number of trips made by people with disabilities in a year due to the action (in the column “Total Change in Annual Trips Made”)

4.3.1.2 Estimating the Travel Impact on All Travelers

ATTRI technologies may benefit not only the ATTRI stakeholder groups, but also have spillover effects on other travelers. When we estimated the travel impacts of potential actions on all travelers, we first assessed the possible impacts on people without a disability, and then combined the impacts for all travelers.

Some of the potential actions will not benefit people without a disability. Action #1, enhancing awareness of disability needs, and Action #4, providing user subsidies, are narrowly targeted at the ATTRI stakeholder groups, so they would not have any substantial impacts on those without a disability.

Most other actions, however, would benefit all travelers through helping private enterprises develop and deploy travel related technologies in general. Action #2, providing funding for enabling technology deployment, is expected to have relatively high impacts on all population since the same new infrastructure installed would allow deployment of any technologies relying on it. Actions #5, 6, and 7, which address liabilities, are expected to have medium impacts relative to other potential actions. The focus of Actions #5, 6 and 7 is potential liabilities of developers of ATTRI technologies, but the benefits of those three actions would spill over to people without a disability through those ATTRI technologies that benefit all travelers, e.g. wayfinding applications. Action #3, providing funding for pilot studies and assist small market deployment of technologies, also focuses on ATTRI technologies like Actions #5, 6 and 7. Similarly, spillover effects of ATTRI technologies make it possible that Action #3 would benefit all travelers, but the benefits of this action are less obvious. Therefore Action #3 is estimated to have low impact relative to other potential actions for people without a disability. Lastly Action #8, emphasizing regulations to eliminate barriers in the public right-of-way, is also estimated to have relatively low impact since barriers in sidewalks are less prohibitive to people without a disability than people with disabilities, but better sidewalk condition would nonetheless make traveling easier for all.

It has been established that the travel impact range of the potential actions for ATTRI stakeholder groups is 0% to 5%. For people without a disability, the magnitude of travel impact is expected to be much lower, due to the actions’ focus on people with disabilities. The travel impact on people without a disability is estimated to range from 0% to 0.2%.

The estimated impacts on trip rate were applied to Equation 1. The base trip rate is 4.06 for people without disabilities prior to implementation of any potential action. Table 6 shows the key statistics and estimated travel impacts on people without a disability and overall travel impacts on all travelers.

Then the total estimated travel impacts for people without a disability were added to the total impacts for people with disabilities to get the overall travel impacts on all travelers. The estimated travel impacts of Actions #1, 2, and 8 are well over 1 billion trips increase per year. A ranking of “high” was assigned to those actions. The estimated travel impact of Actions #4, 5, 6, and 7 are over 0.5 billion trips increase per year. A ranking of “medium” was assigned to those actions. Action #3 was assigned a “low” ranking, as its estimated impact was less than 0.2 billion trips increase per year.

4.3.2 Business and Economic Impact

The business and economic impact assessment was built on the travel impact assessment. The annual gross economic benefits of each action calculated in Table 7 and Table 8 were estimated by multiplying the numbers of additional trips per year for people with disabilities and those without disabilities estimated in Table 5 and Table 6, and the economic value of each trip. The calculated benefits do not take into consideration the cost of implementing each action. The economic value of each trip was estimated based on guidance from the Federal Emergency Management Agency (FEMA), which assumes a delay time of half-day (12 hours) per trip to reflect the loss in productivity and spending for each trip that is not made (i.e. when the trip does not happen, the economy is less productive and there is less spending overall).⁹⁵ Therefore, this analysis assumes that the loss of a trip is equal to a trip not taken - each having a similar impact on the overall economy. Since the value of time for local travel for personal and business purposes is \$13.85 per hour in 2016 dollars⁹⁶, each new trip represents a gross benefit of approximately \$166.^{97,98,99} The gross economic benefit per trip considers the growth and wealth creation that benefits everyone, not only the traveler (health providers, retail stores, transportation companies, etc.). For action items ranking high, the estimated gross economic benefit is approximately \$230 billion (i.e. 0.31% of GDP), while for each medium ranking action item the benefits could be between \$92 billion and \$138 billion (i.e. 0.13%-0.19% of GDP).

⁹⁵ Federal Transit Administration, 2014, *How to Use the FTA HMCE Tool*. http://www.fta.dot.gov/documents/FTA-User_Guide-final.pdf

⁹⁶ The GDP deflator was used to convert the annual earnings in 2014\$ (\$39,300) to 2016\$ (\$40,463). <https://www.whitehouse.gov/sites/default/files/omb/budget/fy2017/assets/hist.pdf>, pages 130-131.

This assumes that a fully employed person with disabilities earns more than \$16,038 per year in 2006 dollars which makes him/her not a candidate for the Supplemental Nutrition Assistance Program (SNAP), the Supplemental Security Income (SSI), Medicaid, or the Federal Public Housing Assistance. Eligibility to any of the previously mentioned federal programs allows a person to apply for the LifeLine Program.

These calculations are very conservative since they do not include the active people with disabilities that are employed on a part-time basis, or is less than 21 years old or more than 64 years old, and is not eligible for government assistance programs. Probably the pool of prospective candidates is larger than estimated above.

<https://www.jrf.org.uk/report/disabled-peoples-costs-living>

<https://www.jrf.org.uk/sites/default/files/jrf/migrated/files/1859352375.pdf>

<http://disability-studies.leeds.ac.uk/files/library/disablement-income-group-opcs-survey.pdf>

⁹⁷ 2016 TIGER BCA Guidance

<https://www.transportation.gov/sites/dot.gov/files/docs/BCA%20Resource%20Guide%202016.pdf>

⁹⁸ The GDP deflator was used to convert the travel time value in 2014\$ (\$13.45) to 2016\$ (\$13.85).

<https://www.whitehouse.gov/sites/default/files/omb/budget/fy2017/assets/hist.pdf>, pages 130-131.

⁹⁹ A new trip gross benefit is 12 hours times \$13.83 (i.e. 2016 value of time).

Table 5. Travel Impact Assessment of Potential Actions on Persons with Disabilities

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	Ranking	Trip Rate Impact	Base Trip Rate	Market Size (Pop. With Disabilities)	Total Change in Annual Trips Made (in million)
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	High	+5%	2.60	29,154,562	1,383.4
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for enabling technology development and deployment	Medium	+2%	2.60	29,154,562	553.4
3			Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • o first-mile and last-mile mobility solutions 	Low	+0.5%	2.60	29,154,562	138.3
4		Affordability of emerging products/services	Provide user subsidies, e.g. subsidized TNCs, smartphones	Medium	+2%	2.60	29,154,562	553.4
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Provide guidance on liability and indemnification issues	Medium	3%	2.60	29,154,562	830.0
6			Potential limitation of liabilities for new business ventures	Medium	3%	2.60	29,154,562	830.0
7			Potential limitation on utilization of ATTRI related development efforts in tort litigation	Medium	3%	2.60	29,154,562	830.0
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	High	+5%	2.60	29,154,562	1,383.4

Source: AECOM.

Table 6. Assessment of Travel Impact on All Travelers for Potential Actions (including People with Disabilities)

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	People without a Disability					Total Change in Annual Trips Made by People with Disabilities (in million) (B)	Total Change in Annual Trips Made by All Travelers (in million) (A) + (B)	Ranking of Impact for All Travelers
				Ranking of Trip Rate Impact	Trip Rate Impact (%)	Base Trip Rate	Market Size	Total Estimated Impact (A)			
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	None	0.00%	4.06	253,899,438	-	1,383.4	1,383.4	High
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for enabling technology development and deployment	High	0.20%	4.06	253,899,438	752,507,154	553.4	1,305.9	High
3			Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • o first-mile and last-mile mobility solutions 	Low	0.01%	4.06	253,899,438	37,625,358	138.3	176.0	Low

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	People without a Disability					Total Change in Annual Trips Made by People with Disabilities (in million) (B)	Total Change in Annual Trips Made by All Travelers (in million) (A) + (B)	Ranking of Impact for All Travelers
				Ranking of Trip Rate Impact	Trip Rate Impact (%)	Base Trip Rate	Market Size	Total Estimated Impact (A)			
4		Affordability of emerging products/services	Provide user subsidies, e.g. subsidized TNCs, smartphones	None	0.00%	4.06	253,899,438	-	553.4	553.4	Medium
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Provide guidance on liability and indemnification issues	Medium	0.02%	4.06	253,899,438	75,250,715	830.0	905.3	Medium
6			Potential limitation of liabilities for new business ventures	Medium	0.02%	4.06	253,899,438	75,250,715	830.0	905.3	Medium
7			Potential limitation on utilization of ATTRI related development efforts in tort litigation	Medium	0.02%	4.06	253,899,438	75,250,715	830.0	905.3	Medium
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	Low	0.01%	4.06	253,899,438	37,625,358	1,383.4	1,421.0	High

Source: AECOM.

Table 7. Economic Impact Assessment of Potential Actions on People with Disabilities

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	Trip Rate Impact	Total Change in Annual Trips Made (in million)	Ranking	Total Est. Gross Economic Benefit	
							(Billion 2016\$/Year)	(% GDP)
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	5%	1,383.4	High	\$ 229.89	0.31%
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for enabling technology development and deployment	2%	553.4	Medium	\$ 91.96	0.13%
3			Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • first-mile and last-mile mobility solutions 	0.5%	138.3	Low	\$ 22.99	0.03%
4			Affordability of emerging products/services	2%	553.4	Medium	\$ 91.96	0.13%
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Provide guidance on liability and indemnification issues	3%	830.0	Medium	\$ 137.93	0.19%
6			Potential limitation of liabilities for new business ventures	3%	830.0	Medium	\$ 137.93	0.19%
7			Potential limitation on utilization of ATTRI related development efforts in tort litigation	3%	830.0	Medium	\$ 137.93	0.19%
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	5%	1,383.4	High	\$ 229.89	0.31%

Source: AECOM.

Table 8. Economic Impact Assessment of Potential Actions on All Travelers

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	Change in Annual Trips Made by Persons with Disabilities (in million)	Change in Annual Trips Made by People without Disabilities (in million)	Total Change in Annual Trips Made (in million)	Ranking	Total Est. Gross Economic Benefit	
								(Billion 2016\$/Year)	(% GDP)
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	1,383.4	-	1,383.4	High	\$229.89	0.31%
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for infrastructure installation	553.4	752.5	1,305.9	High	\$217.01	0.29%
3			Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • first-mile and last-mile mobility solutions 	138.3	37.6	176.0	Low	\$29.24	0.04%
4		Affordability of emerging products/services	Provide user subsidies, e.g. subsidized TNCs, smartphones, and other	553.4	-	553.4	Medium	\$91.96	0.13%

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	Change in Annual Trips Made by Persons with Disabilities (in million)	Change in Annual Trips Made by People without Disabilities (in million)	Total Change in Annual Trips Made (in million)	Ranking	Total Est. Gross Economic Benefit	
								(Billion 2016\$/Year)	(% GDP)
			technologies underutilized due to affordability challenges						
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Provide guidance on liability and indemnification issues	830.0	75.3	905.3	Medium	\$150.44	0.20%
6			Potential limitation of liabilities for new business ventures	830.0	75.3	905.3	Medium	\$150.44	0.20%
7			Potential limitation on utilization of ATTRI related development efforts in tort litigation	830.0	75.3	905.3	Medium	\$150.44	0.20%
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	1,383.4	37.6	1,421.0	High	\$236.14	0.32%

Source: AECOM

4.3.3 Feasibility of Proposed Actions

4.3.3.1 Timing of Action

The action of enhancing awareness of disability needs and universal design methodology (Action #1) can be implemented by ATTRI through an awareness campaign. Preparation of the campaign can start almost immediately. Similarly, ATTRI can start to implement Actions #5 and 8 now. The actions are therefore rated “high” for this criterion. However, several potential actions would likely require congressional actions, e.g. the funding actions (Actions #2, 3 and 4) and the action to limit liabilities for new business ventures (Action #6). They receive a “medium” rating for timing. The action to set limitation on utilization of ATTRI related development efforts in tort litigation (Action #7) would likely require a combination of federal and/or state legislations, and that would be a long legal process due to the complexity of the issue. Therefore Action #7 is rated “low” for this criterion. See Column “a) Timing of Action” in Table 9 rankings by this criteria for all potential actions.

4.3.3.2 Dependency on Owner of the Action

Actions that can be implemented by ATTRI or USDOT alone will receive higher priority, for example, enhancing awareness of disability needs and universal design methodology (Action #1) and providing guidance on liability and indemnification issues (Action #5). The action to emphasize existing regulations to eliminate barriers in public right-of-way (Action #8) received a “medium” rating, because public right-of-way is typically within state and local jurisdiction and the action would require efforts to coordinate with state and local governments. The remaining actions (Actions #2, 3, 4, 6, and 7) are rated “low” for this criterion because they depend heavily on legislative actions. See Column “b) Dependency on Owner” in Table 9 rankings by this criteria for all potential actions.

4.3.3.3 Prerequisite Issues

The actions to enhance awareness of disability needs and universal design methodology (Action #1), to provide guidance on liability and indemnification issues (Action #5), and to emphasize existing regulations to eliminate barriers in public right-of-way (Action #8) are ones that ATTRI could start implementing without delay, as these are educational actions with little dependency on technology development, infrastructure investment, or policy and institutional readiness. These three actions are therefore rated “high” for this criterion.

The actions to provide funding for pilot studies (Action #3) and user subsidies (Action #4) are rated “medium”. These two actions require some pre-steps in advance. For Action #3, ATTRI needs to first identify and prioritize technologies most ready for pilot studies, and either identify existing sources of funding or advocate for new funding. For Action #4, ATTRI needs to identify which technologies, products, and/or services should be subsidized, and define who are eligible recipients of the subsidies.

The remaining three actions, i.e. to provide funding for enabling technology development and deployment (Action #2), to set potential limitation on liabilities for new business ventures (Action #6), and to set potential limitation on utilization of ATTRI related development in tort litigation (Action #7), are rated “low” for this criterion, because their implementation requires resolution of more complex issues in advance. For Action #2, infrastructure often is such a large financial commitment that it requires scrutiny in selecting the most cost-effective projects to fund. To justify funding for infrastructure to the Congress, ATTRI would need to take on substantial advocacy efforts in the Congress, USDOT, and among the general public. For Actions #6 and 7, ATTRI would also play an advocacy role, in coordination with other stakeholders such as other government agencies with similar interests and the private sector, to influence

federal and state legislators to take actions to address the liability issue for private technology developers. The prerequisite issues and actions required for these three actions are more complex and challenging than Actions #3 and 4, so they received lower ratings than Actions #3 and 4. See Column “c) Prerequisite Issues” in Table 9 rankings by this criteria for all potential actions.

4.3.3.4 Alignment with USDOT and ATTRI Priorities

The potential actions all directly address one or more of these areas. Therefore all actions are rated “high” for this criterion. See Column “d) Alignment with USDOT and ATTRI Priorities” in Table 9 rankings by this criteria for all potential actions.

4.3.3.5 Alignment with the Interests of USDOT Constituencies

For example, the action of enhancing awareness of disabilities needs and universal design methodology (Action #1) would benefit technology users, private enterprises, and policy makers. It is therefore rated “high” for this criterion. Similarly, the funding actions (Actions #2, 3 and 4) are rated “high” because they benefit a wide range of USDOT constituencies. The action to provide guidance on liability and indemnification issues (Action #5) and the action to emphasize existing regulations to eliminate barriers in the public right-of-way (Action #8) are educational or informative in nature; implementation of the two actions would benefit the targeted audience, private enterprises and local governments respectively, as well as people with disabilities as the users. However, the actions to limit liabilities for new business ventures (Action #6) and to limit utilization of ATTRI related development efforts in tort litigation (Action #7) would receive mixed reactions from different constituencies – these actions would mainly benefit private technology developers, but technology users may be concerned that these actions would compromise their interests. Therefore they are rated “medium” for this criterion. See Column “e) Alignment with Interests of USDOT Constituencies” in Table 9 rankings by this criteria for all potential actions.

4.3.3.6 Overall Feasibility Assessment

Based on the evaluation of each feasibility criterion, an overall feasibility ranking is assigned to each potential action. Numerically, the rankings were assigned a score – “high” is 5, “medium” is 3, and “low” is 1. Each feasibility criterion carries the same weight. The overall feasibility ranking is therefore based on the average of the numerical scores of rankings for each action. Actions that score 4 or higher received an overall feasibility ranking of “high”; actions that score at least 3 but not higher than 4 received an overall feasibility ranking of “medium”; actions that score below 3 received an overall feasibility ranking of “low”. The evaluation results of all feasibility criteria are summarized in Table 9.

4.3.4 Prioritization of Potential Actions

An overall priority ranking was calculated for each action, which was intended to comprehensively reflect the assessment results based on the proposed criteria and help ATTRI prioritize the potential actions for implementation.

The overall priority rankings were derived from the rankings of the potential actions by three assessment criteria:

- Travel impact on all travelers
- Economic and business impact on people with disabilities
- Feasibility

The selection of these three criteria for overall priority ranking widely represents all proposed criteria for action evaluation. Travel impact on all travelers includes travel impact on each of the three ATTRI stakeholder groups, as well as other individuals. The economic and business impact on people with disabilities emphasizes ATTRI's focus on people with disabilities and provides an economic perspective in evaluating the potential actions. While those two criteria evaluate the benefit side of the potential actions, the feasibility criterion evaluates the resources required and difficulties of implementing the actions. Even though the rankings of travel impacts of the ATTRI stakeholder groups were not used to derive the overall priority ranking, their impacts are captured by the travel impact on all travelers.

Numerically, the rankings of actions by those three criteria were assigned a score – “high” is 5, “medium” is 3, and “low” is 1. The two criteria evaluating benefits carry the same weight as the feasibility criterion. That means travel impact and economic impact weigh 25% each, while the feasibility criterion weighs 50%. The overall priority ranking is therefore based on the weighted average of the three numerical scores of rankings for each action. Actions that score 4 or higher received an overall priority ranking of “high”; actions that score at least 3 but not higher than 4 received an overall priority ranking of “medium”; actions that score below 3 received an overall priority ranking of “low”. Table 10 summarizes the impact assessment results of each proposed criterion, as well as the overall prioritization of potential actions.

Several of the recommended action items are broad in scope; the next steps will involve further refinement, evaluation of alternatives, and reformulation of the steps forward. Further, these actions are evaluated with respect to policy, legal, and institutional issues; ATTRI addresses technology opportunities outside the realm of policy, legal and instructional issues, and so these actions might contribute to but do not circumscribe an ATTRI strategic plan.

Table 9. Feasibility Assessment of Potential Actions

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	a) Timing of Action	b) Dependency on Owner of Action	c) Prerequisite Issues	d) Alignment with USDOT and ATTRI Priorities	e) Alignment with Interests of USDOT Constituencies	Overall Feasibility
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	High (5)	High (5)	High (5)	High (5)	High (5)	High (5)
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for enabling technology development and deployment	Medium (3)	Low (1)	Low (1)	High (5)	High (5)	Medium (3)
3			Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • first-mile and last-mile mobility solutions 	Medium (3)	High (5)	Medium (3)	High (5)	High (5)	High (4.2)
4		Affordability of emerging products/services	Provide user subsidies, e.g. subsidized TNCs, smartphones, and other technologies underutilized due to affordability challenges	Medium (3)	Low (1)	Medium (3)	High (5)	High (5)	Medium (3.4)

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	a) Timing of Action	b) Dependency on Owner of Action	c) Prerequisite Issues	d) Alignment with USDOT and ATTRI Priorities	e) Alignment with Interests of USDOT Constituencies	Overall Feasibility
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Provide guidance on liability and indemnification issues	High (5)	High (5)	High (5)	High (5)	High (5)	High (5)
6			Potential limitation of liabilities for new business ventures	Medium (3)	Low (1)	Low (1)	High (5)	Medium (3)	Low (2.6)
7			Potential limitation on utilization of ATTRI related development efforts in tort litigation	Low (1)	Low (1)	Low (1)	High (5)	Medium (3)	Low (2.2)
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	High (5)	Medium (3)	High (5)	High (5)	High (5)	High (4.6)

Source: AECOM.

Note: Feasibility score in parenthesis.

Table 10. Summary of Potential Actions Evaluation and Prioritization

#	Action Group	Action Item	Assessment of Action Benefits		Feasibility Assessment (weight = 50%)	Overall Priority
			Travel Impact – All Travelers (weight = 25%)	Economic / Business Impact – Persons with Disabilities (weight = 25%)		
1	Awareness of Disability Needs	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	High	High	High	High
2	Funding	Provide funding for enabling technology development and deployment	High	Medium	Medium	Medium
3		Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • o first-mile and last-mile mobility solutions 	Low	Low	High	Medium
4		Provide user subsidies, e.g. subsidized TNCs, smartphones, and other technologies underutilized due to affordability challenges	Medium	Medium	Medium	Medium
5	Technology Risks	Provide guidance on liability and indemnification issues	Medium	Medium	High	High
6		Potential limitation of liabilities for incubator enterprises	Medium	Medium	Low	Low
7		Potential limitation on utilization of ATTRI related development efforts in tort litigation	Medium	Medium	Low	Low
8	Change in Institutions and Policies	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	High	High	High	High

Source: AECOM.

Chapter 5. Next Steps

For next steps, this research suggests ATTRI should consider carrying out fuller exploration and developing more refined action programs for the proposed action areas, starting with the ones with the highest priorities.

As first steps, ATTRI could evaluate alternative campaigns to promote disability needs and universal design for both physical products and ICTs (Action #1). The campaigns could target private technology developers and policy makers, and proactively involve the disability community in three-way dialogues with technology developers and policy makers. Possibly as part of these educational campaigns, or through alternatives, ATTRI could promulgate existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation for policy makers from state and local governments (Action #8). As ATTRI carry out awareness enhancement campaigns, it could study the feasibility and possible models for establishing a certification program for product and service accessibility.

The proposed action to fund pilot studies and assist small market deployment (Action #3) is another one that ATTRI could implement quickly. In fact, during the course of this study, ATTRI issued solicitation of proposals to develop applications for accessible transportation. We recommend ATTRI continue to fund development efforts and consider providing market deployment assistance as technology development becomes mature for commercialization.

The other two potential actions to provide funding (Actions #2, to fund infrastructure required for ATTRI technology deployment and #4 to subsidize ATTRI technology users) require substantially more resources and efforts, as well as collaborations with other stakeholders. While ATTRI advocates for those funds, a relatively easy immediate step would be to document the existing, though fragmented, sources of funding for technology developers and people with disabilities. A comprehensive funding resource guide could be published and periodically updated to help interested parties identify possible funds.

Meanwhile, ATTRI could plan for resources to develop guidance on liability and indemnification issues for technology developers (Action #5). This may require securing dedicated budget in the coming fiscal year for hiring consultants, publishing a guidebook, and promotion activities.

The actions to limit liability risks for technology developers (Actions #6 and 7) require legislative actions, which will require substantial review and planning if a decision is made to proceed with a legislative recommendation. ATTRI could contribute to the review phases by conducting or facilitating research in the two areas, i.e. potential limitation of liabilities for new business ventures and potential limitation on utilizing ATTRI related development in tort litigation.

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Appendix A. Institution and Policy Requirements for Specific Scenarios

Chapter Chapter 2 identifies institutional, policy and legal issues in the development and deployment of advanced transportation technologies for the three primary ATTRI groups. Chapter Chapter 3 analyzes Personally Identifiable Information (PII) privacy and governance issues. This appendix examines four hypothetical scenarios of travel by members of the ATTRI groups; identifies advanced technologies that could enhance those individuals' mobility; and analyzes the institutional, policy, and legal issues that arose in the scenarios. Concerns about individual privacy and about developer and provider liability occur in all scenarios. After the individual scenarios, the privacy considerations which cut across all scenarios are set out. Finally analysis of the scenarios identifies implications for action areas to mitigate the issues.

A.1. Scenario Overview

Scenarios focus on an individual traveling between points using various ATTRI technologies:

- Scenario 1: Safe Intersection Crossing and Wayfinding
- Scenario 2: Wayfinding and Navigation
- Scenario 3: Pre-trip Concierge, Visualization, and Wayfinding
- Scenario 4: Automation and Robotics

The scenarios are aligned to the concept of operations application areas. Each scenario includes a description of the following:

1. Person
 - a. Needs and disabilities
2. Transportation
 - a. Route, beginning and end locations
 - b. Modes of transportation used
3. Technology
4. Institutional (government and private) and policy issues

Specific technologies, institutions, and governments are not named, but generalized for illustrative purposes. Following the cross-cutting privacy discussion, the paper concludes by identifying implications of the evaluations for agency action.

A.2. Scenario 1: Safe Intersection Crossing and Wayfinding

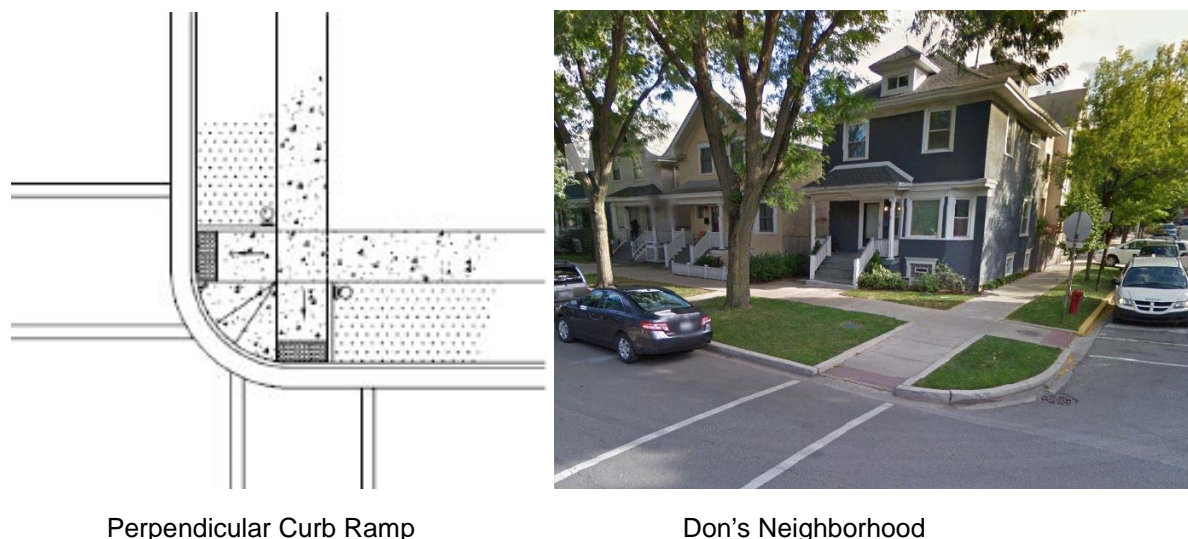
This scenario is based on the mobility needs of Don, a 50-year old Navy veteran with low vision. The scenario is first described in terms of the basics of Don's personal life, his travel needs and routes, enabling technologies available to improve his mobility, and institutional and policy issues regarding deployment of those technologies. He has difficulty traveling to sports venues at intersections and on mass transit. In Don's scenario, the technologies he could benefit from fall into the ATTRI technology areas of Wayfinding and Navigation Solutions, ITS and Assistive Technologies, and Data Integration. The institutional and policy issues of those technologies are evaluated in the context of Don's neighborhood, municipal governments, and transportation service providers. Development and deployment of ATTRI technologies and deployment of more conventional technologies could substantially improve his access to sports venues and access to many more job opportunities.

A.2.1. Scenario Description

1. Person
 - a. Don is a 50 year old Navy veteran who has low vision and is unable to drive a vehicle. He lives with his wife and teenage son in a Midwestern city, about 5 miles from the city center, near a popular sports venue, multiple parks, and not far from a transit rail line. Don would like more options for attending sporting events, and he is worried about how he will get to work when he returns to civilian employment. The US Department of Veterans Affairs provided him with training on how to use the white cane to travel independently.
2. Route
 - a. From Don's home to sporting event venues, he may encounter maintenance work along sidewalks, and need to cross a number of intersections and crosswalks, at both signalized and unsignalized intersections
3. Technology --- Primarily pedestrian-related.
 - a. Wayfinding app on phone identifies the most accessible path, and triggers the pedestrian crosswalk signal at intersections
 - b. Don's phone communicates with short-range wireless communications technologies embedded in the traffic signals, connecting via Bluetooth to Don's earpiece
 - c. Due to the limits of technology, there may be errors in localization, leading to incorrect determination of which side of the street or corner Don is located
 - d. Don's cane serves as a mobility tool, allowing him to navigate more confidently.
4. Institutions and policy issues:
 - a. The City's deployment and maintenance of crosswalk technologies
 - b. Travel training availability and pedestrian environment expectations
 - c. Liability of app provider
 - d. Sporting event sponsor/venue accessibility for individuals with low vision.

A.2.2. Scenario Evaluation

The neighborhood in which Don resides is particularly well-suited for navigation by a white cane user. The presence of planter strips, consistent sidewalk widths, perpendicular curb cuts with detectable warnings and typical four-way stop intersections accommodate the needs of individuals with low vision and is a more accommodating environment than better than most streetscape typologies.



Source: Left image: U.S. Access Board, 2007¹⁰⁰

Right image: Google Map Street View, 2016¹⁰¹

Figure 1. Perpendicular Curb Ramp

The landscape area, between the curb and the pedestrian access route (PAR), allows adequate room for construction of directional perpendicular curb ramps. This layout typically allows curb heights to be maintained, which is not only beneficial to grading and drainage design, but also helps to prevent vehicles from turning too sharply and cutting across the corner of the sidewalk area and into the PAR.

The Perpendicular Curb Ramp design allows the curb ramp to be placed directly in line with the sidewalk and the crosswalk, and the vertical curb edge, bordering the landscaped areas, provides excellent directional cues to pedestrians who are blind or visually impaired, making it easier for them to align themselves with the roadway crossing. Additionally, paired curb ramps are better suited to meet the separation requirements for accessible pedestrian signal (APS) systems.

A number of new APS technologies are now available, e.g. FHWA SBIR Smart Alert System¹⁰² and Multimodal Intelligent Traffic Signal System (MMITSS)¹⁰³. Like traditional APS devices, these new APS applications can communicate information related to the pedestrian signal phase (“WALK” and “DON’T WALK” intervals), in a non-visual format (i.e. tactile arrows, audible tones and vibrotactile surfaces), at

¹⁰⁰ Special Report: Accessible Public Right-of-Way—Planning and Design for Alterations”, Page 82, a 2007 report by the U.S. Access Board Public Right-of-Way Access Advisory Committee, Subcommittee on Technical Assistance

¹⁰¹ Google Map Street View, retrieved in June 2016

¹⁰² <https://www.sbir.gov/content/traffic-signal-alert-system-smartphone-users-intersection-crossing-0>, access January 31, 2017

¹⁰³ <https://www.itsfor.net/index.php/mmitss>, accessed January 31, 2017

signalized intersections; additionally, they interact with pedestrians' mobile devices, such as smartphones, to provide personalized information. Such APS can also provide information related to:

- Presence and location of a pushbutton
- Notification of the WALK interval
- Direction of the pedestrian crossing and the destination curb
- Intersection street names (in Braille, raised characters, with tactile arrows and audible messages)
- Intersection geometry (via tactile maps/diagrams or audible messages)
- Extended button press to actuate optional APS features (e.g. audible messages, louder signals and extended crossing time)

New APS interactive with mobile devices, such as SBIR Smart Alert System and MMITSS, could be a useful tool for Don, helping him to safely navigate the streets in the areas beyond his immediate neighborhood, where navigation with a cane becomes more complex. Don can easily walk the four block distance from his home to the city's major league baseball park, but the intersections beyond Don's neighborhood are signalized, busier intersections than those close to his home. Near the ballpark, the sidewalk landscaped areas disappear, and the sidewalks become expanses of concrete, which make travel for a cane user, especially a beginner, more challenging. One specific intersection, with oblique angles, would be particularly challenging for Don to navigate independently. Don could also walk to the bus stop near his home, and ride a city bus for a short distance to get to the ballpark, but the challenge of crossing the intersection with oblique angles would remain a challenging element of the journey.

The city's transit system provides bus and rail service for the city and neighboring communities. The transit authority offers an "Accessibility Video," available on DVD upon request through the agency's Customer Service office. Currently, however, it does not appear that there is a direct link (in an accessible format) from the agency's website to the video. Simply providing a link to this video would provide greater ease of access to valuable information for persons with disabilities and their families.

The city's transit system does have many accessibility features, and the agency is planning to achieve 100% accessibility within the next 20 years. Currently, all trains in the system reportedly have Braille signage, priority seating, and provide both interior and exterior stop and route automated voice announcements. These are all amenities that can make travel on public transit somewhat less challenging to blind and low vision individuals. However, it does not appear that all city buses are similarly equipped with stop announcement devices.

In addition to the city's fixed route transit service (bus & rail), paratransit, a "demand-response" service that requires reservations be made in advance, is available, as is the city's taxi access program, that allows paratransit certified customers to travel in specially designated taxicabs, at reduced rates, to destinations anywhere within the city.

It is unlikely that Don would be eligible for paratransit service. Paratransit is typically reserved for individuals whose disabilities are significant enough to prevent them from using fixed route service. Alternatively, the transit agency offers discounted fares to persons with disabilities and a travel training program that could teach Don how to use all the various modes of transit (bus and rail) operating within the region. When Don finds employment, this service will be an ideal way for him to learn how to get to and from work. Don may also travel to sports venues on transit, probably with some additional travel

training, at least initially, so that it will not be necessary for him to have a travel companion, thereby allowing him to travel independently. The transit agency's website is equipped with a trip planner that Don could use to help him plan his trips. But the website, like those of many other transit systems, is not fully accessible. Don would need his family's help using it.

However, even if Don is able to independently travel to a sports venue, there is little likelihood that he'll be offered special assistance services at the venue. For example, the city's major league baseball park offers assistance to patrons in wheelchairs, who "ask an associate for assistance." Given the nature of Don's disability, it may be difficult for Don to locate an associate on his own, since no specific location for finding an "associate" is provided on the venue's website, and Don would not be able to visually scan the area to search for an associate upon his arrival. Most sporting venues do not have technology to support independent mobility within their facilities by people who are blind. It is possible to learn the route, but assistance on the first visit would likely be needed.

As technologies continue to develop, such as Bluetooth in smartphones, Don's ability to navigate safely and easily beyond his immediate neighborhood could be significantly increased. Bluetooth beacons can be used to provide unlimited quantities of information to equipped smartphones and improve location precision so apps know exactly on which corner Don is standing. Armed with only his white cane and a smartphone, Don would be able to travel more confidently, knowing that he can confirm his location, if/when information is provided consistently at most or all intersections or locations of significant importance (public buildings, activity/sports centers, etc.). Bluetooth technology is progressing and Digital Signal Processing systems are improving; the range of the technology is increasing and is a potentially useful wayfinding tool for Don. The information that could be obtained with a Location-Based Engagement (LBE) equipped smartphone, at intersections also equipped with APS, would greatly enhance Don's mobility options. Challenges to implementing this technology include the need for continued software and hardware development, initial cost burden of implementation, and on-going maintenance of the infrastructure. Dedicated short-range communications (DSRC) equipped smartphones, which have been demonstrated as a proof-of-concept, would also work for this application.

A technology called Pedestrian Information and Communication Systems (PICS), currently used in Japan, provides pedestrian traffic signal information and location information for bus stops and public facilities to blind and low vision pedestrians through spoken messages. A traveler, passing within 30 feet of a location where the PICS-A speech system is installed, is able to receive FM radio messages (in speech or vibration mode) on a special receiver. A vibration indicates the presence of a transmitted signal, and a speech message identifies the location. When a pedestrian is within a crosswalk at an intersection, and the receiver device is aimed toward an infrared transmitter, spoken messages related to the status of the pedestrian signal may be received. An additional function of the system allows the pedestrian phase to be extended, when a button on the receiver is pushed.

The other type of PICS system, PICS-B image system, extends signal display time, and provides route guidance and information related to the surrounding area on a visual display, for persons with mobility or hearing disabilities. Both the PICS-A and PICS-B systems use radio frequency (RF) and infrared (IR) technology. Infrared technology is susceptible to blocking but RF is not. Infrared methods are inherently directional, requiring the user to aim their receiver at the IR beacon.

It's important to note that both PICS methods require the user to carry an extra, specialized personal device, which means higher costs and the potential for an "orphan technology."

A.2.3. Base Conditions and Incremental Improvements from Technology

APS cannot be installed if the design cannot accommodate the different needs of blind and low vision individuals while minimize noise pollution to the community. Without eliminating the need to carry an extra, specialized personal device and reducing costs, the utility of PICS is limited. Without additional technology, Don will limit his outings to sporting events. He may be able to attend events that are close to his home and located in familiar areas, but the more distant sporting venues will most likely be beyond his abilities without assistance from new technologies or the necessity of depending on a travel companion. In addition, his choice of employment locations will be severely restricted.

The policy and institutional issues touched upon in this scenario include four relevant barriers to development or deployment of specific technologies Don could use. The city or some authorized entity has not made it a policy priority to deploy APS or a PICS-A technology to all or needed crossings. The sports venues have not made it a priority to deploy blue tooth technologies that could support wayfinding in the venues for Don. There has not been funding to overcome economic barriers, including liability risks, to development and deployment of LBE and DSRC technologies enabling smart phone guidance for Don. The transit provider has not made its web site fully accessible and provided accessible links to access resources.

With comprehensive improvements in the technologies supporting the mobility of a person with his abilities, Don should be able to find better employment sooner, and will materially increase his in-person participation in his favorite teams' exploits.

A.3. Scenario 2: Wayfinding and Navigation

This scenario is based on the mobility needs of Andy, a 16-year old student with cognitive disability caused by Traumatic Brain Injury (TBI). The scenario is first described in terms of the basics of Andy's personal life, his travel needs and routes, enabling technologies available to improve his mobility, and institutional and policy issues regarding deployment of those technologies. In Andy's scenario, the technologies he could benefit from fall into the ATTRI technology areas of Wayfinding and Navigation Solutions, ITS and Assistive Technologies, and Enhanced Human Services Transportation. The institutional and policy issues of those technologies are evaluated in the context of Andy's neighborhood, municipal governments, and transportation service providers. For further analysis of the benefits of the technologies, base conditions without the technologies deployed and incremental conditions with the technologies deployed are established.

A.3.1. Scenario Description

1. Person

- a. Andy is a 16-year-old student with a cognitive disability. He lives with his parents in a suburb of a metropolitan area on the East Coast, and attends a local high school. After school, he participates in the *After All* program at the local Arc. Arc is a nonprofit organization serving individuals, families and employers affected by intellectual and developmental disabilities. Andy is aware that his friends from school use public transportation provided by the county and the major regional transit agency to go to school and to get to places on the weekends, such as the mall and movie theaters. He no longer wants to ride the "dedicated

bus” that picks him up from school to go to the Arc and home. Andy says he wants to use public transportation like everyone else.

2. Route

- a. From Andy’s school to the Arc for *After All* after-school program.

3. Technology

- a. Integrated transit information systems – for example, location-based transit apps with capabilities to provide real-time instructions for transit riders, in-station navigation app using Bluetooth beacons, and augmented reality using smartphones and optical tags
- b. Pre-programmable navigation device/app
- c. Integrated payment systems utilizing “Near Field Communication” (NFC) in smartcards and smartphones to reduce cognitive load when managing multiple accounts so riders do not have to determine how to pay

4. Institutional and policy issues:

- a. The county and the regional transit agency deployment of technologies; and support for usage
- b. Financial requirements for infrastructure installation and data collection for in-station navigation and augmented reality technologies
- c. Navigation app developers incorporation of data of smaller transit systems
- d. Personalized wayfinding devices; affordability
- e. Liability issue

A.3.2. Scenario Evaluation

Andy has chosen to travel by public transit. Due to his disabilities, typical wayfinding signs, trip planning tools, and real-time travel information provided by transit operators, municipalities, and private providers are not sufficient for Andy to correctly identify transit route, direction, stop or station/platform, and vehicle. Advanced universal navigation technologies and assistive technologies have been developed that make traveling alone by transit possible for people with cognitive disabilities under certain conditions.

Wayfinding

A variety of wayfinding technologies are available and have been deployed to various extents. Existing technologies allow map-based navigation applications on smartphones to provide real-time, location-based, step-by-step, door-to-door instructions for transit riders. In several U.S. cities, there are available smartphone apps with capabilities to display real-time transit information and provide real-time navigation instructions, such as alert the traveler to get off a bus at the right stop. Like his classmates, Andy can ride the county’s fixed-route bus to the nearest metro station. The regional rail service will take him within walking distance of his destination at the ARC. The two transit operators that Andy relies on have both made their route, schedule, and real-time vehicle location data available online to the public. Several smartphone applications with reliable location tracking and navigation abilities have incorporated the regional transit system’s real-time data, but none of them have incorporated the county’s. Apparently, the relative volumes of the county’s transit system or other factors have put the system low on the priority list of mobile app developers. For Andy, and other individuals with cognitive disabilities who depend on

smaller transit systems, financial incentives may be required to encourage development of locally and regionally oriented wayfinding apps. Likewise, most transit apps have user interfaces that do not adequately support the needs of people with cognitive disabilities.

An alternative type of wayfinding application that is specially designed for people with cognitive disabilities is available on the market. This wayfinding application allows Andy's parents to pre-program trips in the application with door-to-door, location-based visual and audio instructions. When Andy takes transit from school to The Arc, he will receive pre-programmed real-time audio instructions and visual images of landmarks and notable objects along the route on his smartphone. However, instructions of a pre-programmed trip cannot automatically update when temporary changes of transit service and road conditions occur, or when Andy misses an instruction. Thus, this type of application cannot help Andy make any spontaneous trips that are not pre-programmed, which compromises his independence, privacy, and safety. Despite its imperfect features, obtaining this wayfinding application is costly – for example, a customized Android phone with this application installed is currently priced at about \$1000. This type of application is designed to serve a niche market, people with cognitive disabilities. The limited market size does not appear to attract the necessary competition to drive down price. With maturing wayfinding features of navigation apps designed for all, the appeal of highly personalized visual details and audio instructions of pre-programmed trips may eventually become obsolete.

In-station navigation in underground rail stations is not currently available in any typical map or transit application. The three-dimensional nature of an underground station requires different technologies than street navigation. A major U.S. subway system has developed a Bluetooth based app to help blind and low vision riders navigate the subway system. Bluetooth beacons are installed in multiple locations in a subway station. By communicating with a rider's device, it directs the rider by audio to the correct platform, exit, and train. Transit users with cognitive disabilities like Andy's would also benefit from such an application. The regional transit system that serves the metropolitan area where Andy lives has not yet deployed a similar technology. Deployment of the technology would require investment in Bluetooth beacon installation and development of a smartphone app. The regional transit agency will need to identify and secure funding for this project.

Complex multimodal transit hubs or complicated intersections may be difficult for people with cognitive disabilities to navigate, even with all of the above mentioned applications. A navigation app on smartphones with augmented reality can greatly reduce the cognitive burden of a transit rider. Augmented reality (AR) is a live view of a physical, real-world environment whose elements are augmented by computer-generated sensory input such as sound, video, graphics or GPS data. In this case, an in-station navigation app with augmented reality will be able to show the real, 3-D environment inside a station on a user's smartphone and personalized, real-time, visual and/or audio directions based on the user's planned trip. Existing, mature augmented reality technologies would require a visual data inventory of stations. The regional transit agency that serves the metropolitan area where Andy lives could collaborate with third-party developers to create an in-station navigation app based on the visual inventory according to universal design principles, which would benefit not only people with cognitive disabilities, but also new transit users and others. The collaboration may call for the agency to create the inventory itself and make it available or to allow third parties to create the inventory. Whether or not the agency takes on the job to develop the app independently, the data inventory process is a significant undertaking. It will compete with other projects for the agency's limited financial resources, and prioritization policies will be determinative.

One issue common to most wayfinding technologies is liability. For example, if data are not up to date, a user like Andy who is using a wayfinding app may get lost or even injured. Conspicuous disclaimers that

are legally vetted or assistance in indemnification would help to maintain the interest in developing wayfinding apps and devices.

Transit Fare Payment

For Andy, the task of paying for transit is simplified by tapping his transit payment card on circular targets for both the county's transit and the regional transit. The card is a permanent, rechargeable card that can be used to pay for most transit services in the region with a Near Field Communication payment system. It is plastic, like a credit card, and embedded with a special computer chip that keeps track of the value of the card. Both the county's transit and the regional transit accept payment by this card. Technologies that integrate transit fare payment with other daily payment methods further reduce burdens of personal financial management. This benefits all transit riders, but is especially helpful for individuals with cognitive disabilities. One such solution is mobile payment technology - major transit operators in London, UK now accept mobile payments for transit fare. If both the county's transit system and the regional transit system deploy the technology, Andy can simply use his smartphone for fare payment, eliminating the need to carry and manage a transit payment card. To allow transit riders to pay with their mobile devices, both transit systems that Andy relies on would need to install new fare collection infrastructure.

The transit options and technologies available for Andy have obvious constraints. He may be able to make the regular trip from his school to The Arc on his own, with a pre-programmed wayfinding device; or he could rely on a generic map-based navigation app for street wayfinding and the portion of the transit trip on the regional transit, and receive training to take a county bus for this particular trip. Either way, Andy may be disoriented if the condition of any element of the route changes unexpectedly. To incentivize developers of map-based navigation apps to incorporate the county transit's real-time bus information would greatly benefit Andy. It would not only allow him to complete the trip from school to The Arc independently by transit, but it would also enable him to plan and complete other trips on his own.

There are policy issues to resolve for integrated payment systems when there are multiple transportation agencies. Fortunately, multiple regions have worked through this process so there is experience to draw from for future applications.

A.3.3. Base Condition and Incremental Improvement from Technologies

With training the technologies discussed above should allow Andy to plan and complete transit trips on his own. The technologies will also reduce his cognitive burden to manage personal finance.

Without the wayfinding technologies discussed above, Andy may be able to make transit trips on routes he travels regularly with sufficient training, but he may not be able to plan transit trips for new routes or find alternative route in case of temporary transit service change, even with the help of existing navigation apps. Most navigation apps assume the user can manage certain cognitive tasks which may be difficult for people with cognitive disabilities, and most navigation apps lack specific features desired and needed by this group, such as customized information loaded by caregivers and caregiver notification when someone goes off course.

Without the mobile payment technology, he will have to manage a regional transit payment card in addition to his other financial accounts.

A.4. Scenario 3: Pre-Trip Concierge, Virtualization, and Wayfinding

This scenario is based on the mobility needs of Elaine, a motorized wheelchair user starting a new job in the downtown area of her city. The scenario is first described in terms of the basics of Elaine's personal life, her travel needs and routes, enabling technologies available to improve her mobility, and institutional and policy issues regarding deployment of those technologies. In Elaine's scenario, the technologies she could benefit from fall into the ATTRI technology areas of Data Integration, and Wayfinding and Navigation Solutions. The institutional and policy issues of those technologies are evaluated in the context of Elaine's neighborhood, municipal governments, and transportation service providers. For further analysis of the benefits of the technologies, base conditions without the technologies deployed and incremental conditions with the technologies deployed are established.

A.4.1. Scenario Description

1. Person
 - a. Elaine has limited mobility in her hands and legs from an accident several years ago. She uses a motorized wheelchair. Elaine is starting a new job today as a Human Resources Generalist at a company located in the downtown area of the city where she lives, and will be using the regional transit system to get from her home in a suburb about six miles east of the city to the worksite. She is concerned about finding the most accessible route to the new location.
2. Route
 - a. Home to work along sidewalks, across intersections using crosswalks, using transit/paratransit services
3. Technology
 - a. Participatory sensing - app on phone telling when and where the next bus will arrive and the most accessible path to get there.
 - b. Wayfinding databases and map apps with access data
4. Institutions and policy issues:
 - a. Deployment of pedestrian technologies by the municipality
 - b. State and/or federal policy to standardize machine readable data form across regions
 - c. Extent of mapping service coverage
 - d. Deployment of technologies for and competitiveness of complementary paratransit
 - e. Reliability
 - f. Travel time

A.4.2. Scenario Evaluation

This scenario involves a wheelchair user, Elaine, attempting to use Information and Communication Technology (ICT) in the form of pre-trip concierge, visualization, and wayfinding apps to support a fairly

typical transit commuting trip. She lives in a suburb near the densely urbanized area and needs to commute to a new job in the central business district using transit. She encounters problems using the system of sidewalks, crosswalks, and traffic controls to reach transit, a lack of information on sidewalk accessibility, and lack of access to information concerning complementary paratransit service and a lack of real time information on the transit wheelchair station availability.

Elaine takes an accessible taxi to her job on the first day, but the round trip fare is a prohibitive \$56, before tipping. She is determined to find a reasonable commute, probably using public transit.

She has used the sidewalks in her neighborhood, and has seen some improvement in the sidewalk maintenance and condition, although events such as household construction sometimes require her to detour into the street, which she has been willing to do. She has not ventured out to the arterial road where she knows there is bus service. Although the sidewalks in her neighborhood are narrow and not in compliance with current Americans with Disabilities Act (ADA) standards, she finds them usable. Elaine searches on-line and for apps that will tell her about the accessibility of her routes. One website introduced the ability to add wheelchair accessibility markup into the map database. Unfortunately, no data has been loaded for the neighborhood, either from public sources or by users. An alternative app also was not populated with data for Elaine's neighborhood. Short of venturing out to test the routes, she found that the street view provided by a major web based mapping service was the most useful technology. Although it required substantial effort to load and check the images along her route and they do not specifically address accessibility or always show enough detail, the street view images suggest she might be able to use her wheelchair on the sidewalks along her street to the main road, where she would find a traffic light a hundred yards to the right with a pedestrian crossing and bus stop (serving two directions on either side of the main road).

Her research resulted in four alternative routes that she should be able to use while traveling in her wheelchair:

1. A bus on her main street would allow her to travel to the train station with a free transfer to the train. Then she could travel by train to the downtown and travel along the city street by sidewalk to her employer. The estimated travel time was one hour, assuming there were minimal difficulties navigating the sidewalks. The fare was \$2.00 round trip.
2. A bus to the downtown with one bus transfer and a shorter trip from the bus stop to her employer by sidewalk. The total travel time she estimated at one hour and 20 minutes.
3. A major transit ridesharing and payment (Transportation Network Company) app offers shared rides at a considerably higher cost (\$10 - \$20 round trip), with a travel time of 26 minutes each way, and Elaine noted this service is not wheelchair accessible. She also learned that another transit ridesharing and payment app offers one or more wheelchair accessible options at a higher cost, possibly using taxicabs.
4. A direct ride service is offered for persons with disabilities by the regional transit system. Elaine could not find data comparing this service to any alternatives, including fixed route transit. She called the transit system, who said she might qualify for use of their complementary paratransit system particularly if she was unable to reach a bus stop, but she would have to request an eligibility review. If Elaine is eligible, the service would pick her up at her house and take her to her employer downtown with no transfers, but it might deviate substantially to pick up and drop off other passengers. For this reason, the system cannot guarantee the pick-up or travel times, but based on research, the trip to work is estimated to take 45 minutes or less, at only a slightly higher cost (\$4.00 round trip) than the bus and/or train. The only way for Elaine to get more

specific ride information on paratransit appears to be by telephone or by visiting the direct ride service offices.

Elaine felt torn between the train route and further investigating her eligibility for the complementary paratransit. She felt the complementary paratransit service might be much easier and more convenient, since it would be only one vehicle and scheduled specifically for her. It might even be more reliable than the bus to train transfer because she would not need to contend with unannounced bus schedule problems, detours, construction or inclement weather interrupting her wheelchair segments, or other disruptions beyond her knowledge or control. With the complementary paratransit reservation, she thought it was more likely that she would be informed and able to manage the disruption. However, Elaine was told that she would have to reserve a trip separately for each day, and that there was no guarantee that the schedule would be the same from day to day. She also had been told about reservation “windows,” which indicated that the scheduled trip might be an hour later than her request.

Elaine decided to try the rail option, and downloaded a transit information app with real time bus information for the regional transit system that allowed her to check the status of the next few buses at her stop as well as the next trains for her return trip. However, the app did not indicate whether the wheelchair station on the bus was occupied, nor even how full the bus was on any particular trip. If the wheelchair stations were full, she might have to wait at the stop for a second bus, which would be almost 40 minutes later. Real time information systems typically do not report the fullness of specific buses. These systems could be updated to use real-time automated passenger counter data and to relay the data or some condensed data to the central base; these data could be made available to third party app developers. Alternatively, transit information apps could use participatory sensing to collect reports from riders about vehicle fullness and could potentially report the status of the wheelchair station or tie-downs.

Elaine successfully traveled by bus to the transfer at Lindbergh Station, which was well planned and designed (as long as the elevator was working as communicated by the regional transit agency on its web site and in signage). Similarly, the trip from the train through the downtown station nearest to Elaine’s office, up to the wide sidewalks, and into the Turner Broadcasting offices was very smooth.

A.4.3. Base Conditions and Incremental Improvements from Technology

With no technology improvements in this scenario Elaine may be required to arrange private transportation, which could be cost-prohibitive. More complete ICT data bases on wheelchair accessibility, including both sidewalks and bus fullness, would make her transit trip feasible at a very low cost. Alternatively, more information on complementary paratransit service could give more information on her potential eligibility and increase her interest in that service. If eligible, she would have to compare the services, e.g. trading off the paratransit schedule variability and slightly increased cost for the complete curb-to-curb service. Finally, real-time transit information systems could be expanded to offer more details about the current state of specific buses and vehicles.

A.5. Scenario 4: Automation and Robotics

This scenario is based on the mobility needs of Cathy, a grandmother with hearing loss. The scenario is first described in terms of the basics of Cathy’s personal life, her travel needs and routes, enabling technologies available to improve her mobility, and institutional and policy issues regarding deployment of those technologies. In Cathy’s scenario, the technologies she could benefit from fall into the ATTRI technology areas of Assistive Technologies and Automation and Robotics. The institutional and policy

issues of those technologies are evaluated in the context of Cathy's neighborhood, municipal and state governments, and transportation service providers. For further analysis of the benefits of the technologies, base conditions without the technologies deployed and incremental conditions with the technologies deployed are established. With the technologies, Cathy would avoid some costly private transportation and would greatly increase the number of her excursions.

A.5.1. Scenario Description

1. Person

- a. Cathy is a grandmother who has recently experienced significant hearing loss. She lives with her husband in a condominium in the central area of a Southern coastal city, and provides periodic childcare for two of her grandchildren, aged nine and eleven. While Cathy can drive, her hearing loss is profound and she is uncomfortable driving, especially with the children in the car. She is afraid that due to her hearing loss, she would not be able to hear emergency vehicles or communicate her needs if she is in an emergency situation with the children. While her hearing loss does not prevent Cathy from driving, it significantly increases her discomfort.

2. Route

- a. Between her condominium and nearby attractions and shops such as restaurants, parks, neighborhood pools, and recreational centers, and religious centers.

3. Technology

- a. Partial automation services, apps or automated vehicle technologies that provide situational awareness alerts through remote sensing or connected vehicles, as well as possible "rescue me" alert services. Added technology can be a safety net for Cathy while she is driving.]
- b. Fully automated vehicles operating in and around community. Automated taxi deployments have been proposed in the next five years that require no operator intervention. These vehicles would provide on-demand, short-range rides for people who either cannot drive or do not wish to.
- c. The city proposes to deploy several semi-autonomous vehicles on its Reversible Express Lanes (REL). The vehicle operation would be SAE Level 3, which is described as "conditional automation" requiring a human driver to take control if needed. An auto company, a pioneer in vehicle automation, will work with the city to deploy and test these vehicles, using the city employees as operators. These vehicles will operate in real traffic on a daily basis.
- d. A fully automated downtown shuttle vehicle is proposed for central area of the city which would interface with transit. These are considered shared ride-type vehicles since they can pick up and drop off multiple riders along a route. The city proposes that the automated vehicle company will deploy the low-speed multi-passenger shuttles in the downtown. The vehicle operation would be SAE Level 5, which is described as "full automation" that is full-time performance by an automated driving system. The downtown partnership of the city will lead the deployment of an on-demand downtown shuttle that connects existing transportation options (intercity rail, intercity bus, bike share, water taxis, and street cars) and important destinations in the city (scenic riverfront, museums, and signature parks). The complementary shuttle will provide increased mobility and accessibility opportunities to vulnerable populations. Downtown Guides of the city will serve as remote operators of the shuttles, providing city information and helping passengers with disabilities.

4. Institutions and policy issues:
 - a. Permissibility of automated vehicles
 - b. Liability of service providers/equipment manufacturers
 - c. Integration of dedicated short range communications (DSRC), vehicle to vehicle (V2V), or vehicle to infrastructure (V2I) with other short range communications
 - d. Equipment/communication standards
 - e. Payment for the systems
 - f. Defining area of service for automated shuttle vehicles

A.5.2. Scenario Evaluation

Deaf and hard of hearing people have the same requirements for obtaining and retaining a vehicle driver's license as people with full hearing. Therefore, Cathy's loss of hearing does not present a legal or regulatory obstacle that would prevent her from continuing to drive her own vehicle. Rather, she is uncomfortable driving because of her concern with hearing emergency vehicles and communicating her needs in an emergency.

There are multiple technologies currently available that can be installed in a vehicle to alert a driver to the presence of an emergency vehicle or a honking horn. Most of these technologies are activated by sound or light and are relatively inexpensive as after-market products. While these technologies can aid all drivers, they are not standard features on vehicles. Portable products are also available that can alert people to sirens. Therefore, if Cathy wishes to continue to use her own vehicle, technologies exist that can aid in addressing her concern with being alerted to the presence of emergency vehicles while driving or walking. These existing technologies do not face major policy, institutional, or regulatory issues. However, many of these options are niche products with limited or no competition and limited markets that may suffer from orphan technology problems. The companies that offer them can go out of business, leaving the community without an alternative unless the research cycle leads to a replacement technology or the capability is incorporated into the vehicle technology. Universal design methods that utilize more widespread technology (e.g., Dedicated Short Range Communications incorporated into standard vehicle systems) would protect against this problem.

In addition to the existing technologies that can aid Cathy in comfortably operating her own vehicle, more advanced technologies are being developed that will provide drivers with information on the location and travel direction of emergency vehicles - enabling drivers to take appropriate action. Some of these technologies use transponders to relay information from an emergency vehicle to personal or commercial vehicles, bicyclist, or pedestrians (some via a smartphone app). While these technologies exist and are being tested and refined, deployment may be hindered by policy and/or institutional issues. First, municipalities will need to make funds available to install the transponders on the emergency vehicles and any associated infrastructure, and will then need to maintain the technology over time. In addition, some emergency services may be reluctant to install the technology (e.g., police may have concerns with identifying their location to suspects). Once the transponder technology is installed, the public will need to install the receiving device on their vehicle or install an app on their smartphone. Vehicle manufacturers may be reluctant to install this technology as a standard feature until there is a uniform technology standard and there is sufficient demand, or they are required to provide it through the regulatory process.

If Cathy does not wish to continue to drive her own vehicle, other options may provide her with mobility. Some of these options are currently available while others are still being developed and deployed. In central Tampa, multiple public transit, taxi, and transportation network companies (TNCs) options exist that could provide Cathy mobility around the city. However, public transit may not get Cathy close to her neighborhood destinations (e.g., religious facility, grocery store) and may be difficult to manage with small grandchildren. While taxis and TNCs could provide destination flexibility and be easy to use with small grandchildren, they may be cost prohibitive to use on a frequent basis.

As discussed in Chapter Chapter 2, TNCs have the potential to work with cities to support the needs of persons with disabilities. However, significant issues have hindered the TNCs and cities from reaching an agreement. These issues have included insurance and liability concerns and interaction between TNC and city databases. While these issues can be resolved, it will take funding to overcome the database issues and the political will from the city to relinquish control of their disability services and to provide long-term financial support to operate the services.

To support people with disabilities, TNCs have been providing specialty services in selected cities that allow users to request services that meet their needs (e.g., wheelchair accessible van). In Cathy's situation, no specialty services would be required for her to use a TNC, but the service may need to be financially supported from outside sources for her to afford to use the services to meet day-to-day needs. For other people with disabilities, the ability to use a TNC may be more difficult due to special vehicle requirements and/or ability to use a smartphone to arrange a trip that has not been pre-planned.

Vehicle automation may provide Cathy with mobility options that give her flexibility in her destination and ability to manage small grandchildren. There is a broad spectrum of possibilities when discussing vehicle automation. On the basic end of vehicle automation, many production vehicles now offer automated features that can reduce accidents and improve safety, such as automatic braking and lane indicators. These features still require that a person operate the vehicle, and therefore, do not pose any regulatory, policy, or institutional challenges. However, these features are primarily found on high-end vehicles, and may be difficult to obtain for people with limited financial resources. While many of these features would make Cathy safer and more confident driving, they do not necessarily address her concern of not being able to hear an emergency vehicle.

On the advanced end of the spectrum, fully automated vehicles are being developed and tested, which would not require input from a driver – basically leaving all occupants in the vehicle as passengers. A fully automated vehicle would allow Cathy the mobility that she needs for day-to-day activities and the ability to manage small grandchildren. However, fully automated vehicles face a number of policy, institutional, and regulatory issues. As discussed in Chapter Chapter 2, developers, communities, and states are still grappling with many issues, including whether a driver's license would be needed by an occupant, how much liability should the technology developers be responsible for, and should there be regulatory consistency across the U.S. In this scenario, the state has made it legal for anyone with a state driver's license to operate a fully automated vehicle on the road. However, the laws and regulations governing automated vehicles vary considerably state-to-state. Until these issues are resolved, deployment of fully automated personal vehicles may be limited. These issues are highlighted by the recent death of a driver who was using the autopilot mode of a Tesla. The vehicle did not brake because the sensors did not recognize the danger. The occurrence may cause concern among the general public and companies developing these technologies, accentuating liability issues and increasing the likely regulatory burdens.

In addition to fully automated personal vehicles, communities are exploring the idea to fully automate transit options. These options could include a fully automated bus that runs a specific route and shuttle

service that would address barriers or other issues along the “last mile” between a fixed route transit stop and the rider’s destination or origin. However, deployments of fully automated transit options face many of the same challenges as fully automated personal vehicles. They also have the added difficulty of needing to be able accommodate passengers with a wide range of disabilities as well as the need for public funding for purchasing vehicles and installing infrastructure.



Source: Local Motors¹⁰⁴

Figure 2. Example of Autonomous Shuttle

Cathy may realize the benefits of a fully automated personal vehicle or transit option, as her state has made an effort to be a leader in the automated vehicle movement by becoming an early adopter of automated vehicle technologies and conducting pilot projects. According to the State Department of Transportation (FDOT), the goals of the pilot projects are to:

- Leverage existing infrastructure to maximize benefits
- Develop rich datasets that demonstrate quantitative safety and efficiency gains
- Set performance measures
- Establish comparative analysis before and after automated vehicles are deployed

The State DOT has partnered with a number of the regional transit authorities in the metropolitan area where Cathy lives to conduct pilot projects on some automated technologies. One of the pilot projects in city may be testing of autonomous shuttles. The goals of the shuttles would be to reduce accidents and to keep traffic flowing. Because Cathy lives in the central area of the city, autonomous shuttles may benefit her by providing access to larger transit options, such as an established bus or streetcar route. However, it is not clear if operating shuttles would be confined to selected neighborhoods, or if they would be available to transport passengers to other parts of the city. A shuttle operating within a limited range would require that passengers transfer to others transit systems, which may be a hindrance for people with disabilities.

If Cathy has an autonomous shuttle service available to her, she and other older adults may be uncomfortable using the service because of concerns with use of technology, loss of control, reliability of the system, and liability. There is also the extra responsibility for Cathy if she is babysitting her small grandchildren. Cathy’s concerns with using a shuttle with her grandchildren may include:

¹⁰⁴ <http://www.ibtimes.co.uk/meet-olli-self-driving-3d-printed-mini-bus-controlled-by-ibm-watson-that-talks-you-1565900>

- Would the grandchildren be allowed to use the shuttle if they are not in a city sponsored program?
- Would the shuttle have the sensors to ensure that children can get on and off the shuttle safely?
- Who would be responsible if a guest accidentally caused damage to the shuttle?
- Will the shuttle service collect Personally Identifiable Information (PII) about her grandchildren or require her grandchildren to register for the service?

While there are many issues/questions regarding automated vehicle technologies, through ongoing pilot projects it can be expected that there will be extensive and detailed investigation of liability by the city and all the contracting parties involved in the automated shuttle system. The investigation and resulting negotiations will likely result in complex concerns about indemnification and liability for each party, which may result in restrictions for users (e.g., Cathy's grandchildren may not be allowed on a shuttle if they are not in a program). While many of the policy, institutional, and regulatory issues will be investigated/addressed, these issues may not be resolved immediately. While the initial efforts will form a basis, it can be expected that addressing and refining these issues will take time.

Even if the technologies being tested in the city do not directly help Cathy, she will benefit from the lessons learned from the pilot projects and the forward thinking of state and community leaders. Embracing automated vehicle technologies and identifying practical uses for these technologies will lead to advancement and acceptability of the technologies.

A.5.3. Base Condition and Incremental Improvement from Technology

Because of her increasing discomfort with driving, Cathy will choose not to drive her own vehicle, which will substantially limit her travel. For convenience reasons, Cathy will opt to use costly taxis for the most important trips and those with her grandchildren. With technological advancements and availability of autonomous shuttle services, Cathy could comfortably engage in a materially greater number of excursions and maintain her current lifestyle.

A.6. Cross-Cutting Privacy Considerations

A.6.1. Introduction and Common Considerations

All of the scenarios presented in this study face common privacy challenges and, as such, there are common considerations to keep in mind when designing and implementing the discussed accessible transportation technologies. The transportation solutions discussed in the above scenarios have the opportunity to allow newfound mobility to ATTRI stakeholders and, in order to best serve these stakeholders, these solutions must not unduly compromise the privacy of their personal information. As such, the security and privacy of the personal information that accessible transportation technology companies and institutions collect is of the utmost importance.

Unauthorized access, use, or disclosure of information can result in harm to individuals, leading to embarrassment, blackmail, identity theft, and even discrimination. Organizations, too, can be injured by breaches of PII, reducing public trust in the organization and creating potential legal liability and mitigation costs. Because of these potential harms, ATTRI institutions must carefully consider how to best protect

the information they collect while still allowing use of information to advance the creation and use of accessible transportation technologies.

There are a number of important steps and considerations that ATTRI institutions must work through to protect privacy. First, institutions must adhere to all applicable laws – federal, state, local, and even international – when designing and implementing accessible transportation solutions.¹⁰⁵ ATTRI institutions must look holistically at how the different laws, guidance, and policies might apply to technologies when designing and implementing technologies and products.

Additionally, privacy solutions and considerations should be built into product or system designs starting from Day 1, including adherence to the Fair Information Practice Principles (FIPPs) and associated best practices, by leveraging functional reviews by a privacy expert. Dedicating resources to reviewing privacy implications throughout design, development, execution, and interoperability with other systems or products will help maintain continuity and will allow for regular and consistent assessments of privacy impacts to users. Providing this type of dedicated resource to user privacy will also contribute to the users' confidence in and help increase usage of ATTRI technologies and products.

Building privacy into the design of a technology includes, among other considerations, analyzing what data elements an application or product needs to complete specified functions, only collecting those necessary elements, and only using the information for the specified purpose. It also includes protecting information collected by implementing proper security measures and securely destroying information when it is no longer needed. Finally, ensuring that privacy is built into a system requires a continuing analysis of whether the elements of the FIPPs are being met throughout the lifecycle of the technology.

It is also important to emphasize that information that may be particular to accessible transportation technologies, such as health information relating to a disability, is not any different than other types of personally identifiable information (PII). This information needs to be protected with the vigor of any sensitive PII data point, but there are no specialized requirements stemming from the fact that the information might relate back to a disability.

Below are analyses of privacy considerations and mitigations for specific technologies discussed in the Scenarios.

A.6.2. Applications

All of the scenarios discussed above involve the use of applications to assist the ATTRI stakeholder in traveling between locations in their daily life. Applications, or apps, are computer programs designed to perform coordinated functions, tasks or activities for the benefit of the user. Applications often have capability to store troves of personal information, and some ask users to fill out a user profile. Profiles can be used to set up preferences for the types of information or assistance desired, and users can fill out personal information, such as contact and demographic information, financial information, such as the payment data collected for a mobile payment in Scenario 2, certain health information, and location information collected and stored by most wayfinding apps in Scenarios 1, 2, and 3. Additionally, an

¹⁰⁵ A more in-depth analysis of applicable privacy laws and of all of the concepts discussed in this section can be found in Appendix C PII Privacy and Governance Issues.

application may collect this information over time, such as tracking a user's location information or purchase history and storing that information in the user's profile within the application.

Such information collection must be reasonable and relate to the primary purpose of the application, and this information must only be used for this primary purpose unless a secondary use is otherwise explained and consented to by the end user. Applications also usually allow users to select their information-use preferences, including consenting to or opting-out of certain information uses and disclosures. Due to the possible breadth of information contained in the user's profile, this information may be highly sensitive and application makers should take special precautions to ensure that this information is protected.

App users, such as those discussed in the above Scenarios, must be careful when installing and using apps and consider the risks, including those outlined in an application's privacy policy, if one exists, as some applications sell user data. For example, free applications may provide a service to the consumer, but if the application developer is a commercial entity, it has to make money somehow – and this can often happen by selling user information to third parties for advertising purposes.

Applications may also have access to other information in a user's mobile device, such as contacts, maps, or search history. For example, the programmable wayfinding app designed for people with cognitive disabilities mentioned in Scenario 2, allows users to designate emergency contacts and store their contact information. Many applications, however, allow the user to opt-in to certain information collection, usually via privacy settings. Applications also may have pop-ups asking to track the device's location in order to enable certain features. All access to information outside the application's boundary should be explicitly consented to and limited to information required to fulfill the application's purpose and functions.

Some applications may utilize assistance from remote users, thereby creating a potential loss of privacy in exchange for a particular functionality. For example, an imaging processing app allows users who are blind to ask a question about a picture they have taken. Crowdsourced workers, including those from a pool of volunteers as well as those employed by a major crowdsourcing internet marketplace, answer the question, which is then sent back to the user. In this case, the crowdsourced worker can see the picture that was taken by the app user and may learn details about the user. Research has shown people with disabilities are willing to make privacy-functionality tradeoffs, especially as the severity of disability increases. This already happens to some degree, such as when a hearing-impaired individual asks a bystander to make a phone call on his or her behalf, but may increase as reliance on technology increases and the functionality of technology improves.

Finally, accessible transportation technology applications may be developed with the capability to push and pull information to and from other sources, such as third party applications, websites, or data repositories. There are special considerations when transferring data to and from an accessible transportation technology application. Data received from third parties should inherit the security controls (technical, administrative, and physical) used by the data source and be protected at a level commensurate with the level at which it was protected by the third party or higher. When an application transfers data to a third party, proper security controls should be written into data use agreements and contracts to ensure that the data remains protected and that users' privacy is not at unnecessary risk. Applications should also outline any data sharing in their privacy policy, terms of use, and data use agreements, and allow users to opt-in to data transfers, when possible. Additionally, applications should be sure to protect data while in transit through the use of encryption and other security controls.

A.6.3. Location Information

All of the Scenarios discussed above involve technologies that use location information to track a user's GPS coordinates in order to function properly and effectively. Location technologies have made it easier for individuals, including ATTRI stakeholders, to navigate their way around cities, public buildings, and from Point A to Point B. However, research has shown that stored location information can be traceable back to the individual, even when anonymized, and therefore must be protected and only be used for limited purposes.

While seemingly innocent, location data can provide sensitive information about a person's activities, associations, or beliefs if breached or misused. Location information may identify religious and political associations, as well as other information that an individual might not want made public, such as visits to an HIV/AIDS or reproductive clinic or meetings with ex-boyfriends or business rivals.¹⁰⁶ And because cell phones, applications, and other technologies can track where an individual is throughout the day, this can give a very detailed illustration of who the individual is. This ability to paint a detailed portrait of a person can prove lucrative to advertisers, creating an incentive for companies to amass and sometimes sell this information.

Many location and navigation-enabled applications and services need this information in order to function properly and provide a service, such as the wayfinding apps in Scenarios 1, 2, and 3. Turning off location services functionality might not be a reasonable option. However, institutions should only collect location information when necessary for the delivery and development of proper function of their application or device, allow opting-out of providing location information where possible, and should protect this location information from mishandling or loss through stringent security practices. ATTRI stakeholders should protect themselves by reading a device or application's terms of service to make sure that information is not being sold or shared prior to using the technology and should adjust settings in their devices to further protect their information.

A.6.4. Connected and Autonomous Vehicles

Scenario 4, discussed above, introduces a unique and still-developing technology: Connected and autonomous vehicles. Despite the fact that connected and autonomous vehicles have the potential to provide autonomy and convenience, to solve current challenges, and to open up a world of transportation opportunities for ATTRI stakeholders, these technologies come with serious privacy and security – not to mention safety – considerations.

Connected vehicles are vehicles that are equipped with Internet access, and usually also with a wireless local area network. Connected cars allow drivers and passengers to control the car's features and are able to communicate externally via the Internet. This Internet connectivity can allow or simplify such tasks as music playing, using smartphone apps via a dashboard screen, navigation, roadside assistance, voice command, parking assistance, and engine control and car diagnosis.

Autonomous vehicles, in contrast, are vehicles that are capable of sensing their environment and navigating or performing other tasks, such as parking, without, or with little, human input. Autonomous vehicles detect surroundings using radar, LIDAR GPS, odometry, and computer vision. Automated

¹⁰⁶ Such detailed collection of location information can also make the individual more susceptible to theft, stalking, and other physical dangers.

vehicles, such as those studied in ATTRI's Automation and Robotics Research Area, those being designed by certain private tech companies, and those discussed in Scenario 4, provide exciting opportunities to provide transportation services to ATTRI stakeholders and help solve certain problems with implementing accessible transportation technology, such as "first mile" and "last mile" transportation. These vehicles have amazing potential to allow ATTRI stakeholders - such as Scenario 4's Cathy, who has experienced significant hearing loss - increased mobility and independence.

Connected and autonomous vehicles can collect a litany of information, including information about GPS location, trips taken, and personal information, about drivers. Some applications may even have cameras and microphones collecting images and sound within the vehicle. Such information should only be collected when necessary to perform specific tasks. Additionally, such collection should follow the principles laid out in the FIPPs – including properly securing information using such methods as encryption – and any sharing of information with third parties should be minimized and align with practices outlined in privacy policies and terms of service.

Additionally, there have been numerous reports of White Hat researchers hacking into connected and autonomous vehicles, allowing them to access information and even to control the car's utilities and movement. Examples of hackers finding and exploiting security vulnerabilities in conventional vehicles illustrate the potential dangers of this technology – not only for privacy, but physical safety as well – and show the importance of building proper cybersecurity into these vehicles throughout the design process and life cycle to ensure that these vehicles are properly protected and of issuing software patches immediately after any vulnerabilities are discovered.

Children's Online Privacy Protection Act of 1998

Scenario 4's use of shuttling and other TNC technology may involve the collection of information about Cathy's grandchildren, ages nine and eleven; such information collection, which may be used to create user profiles, reservations, or for other similar purposes, is subject to the Children's Online Privacy Protection Act of 1998 (COPPA).¹⁰⁷ COPPA applies to private sector websites and online services that are directed toward and collect personal information online from children under the age of 13. The Act also applies to websites and online services that are directed to a general audience but have actual knowledge that there are users under the age of 13, such as the TNC services that Cathy and her grandchildren use. In 2000, OMB Memorandum 00-13, *Privacy Policies and Data Collection on Federal Web Sites*,¹⁰⁸ extended the provisions of COPPA to Federal websites.

Among its provisions, COPPA requires that applicable website owners post a privacy policy to their website and identifies the content that a Website operator must include in a privacy policy. Additionally, website owners must provide notice about information collection practices to parents; obtain verifiable consent from parents before collecting children's information; give parents choices prior to disclosing children's information to third parties; provide parents access to their child's information and right to delete information and opt out from further collection; and maintain the confidentiality, security, and integrity of personal information collected from children.

¹⁰⁷ Children's Online Privacy Protection Act, 15 U.S.C. §§ 6501-6506 (1998).

¹⁰⁸ Office of Mgmt. & Budget, Memorandum 00-13, *Privacy Policies and Data Collection on Federal Websites* (2000).

Accessible technology providers, such as Scenario 4's shuttle service and TNCs, who cater to or knowingly collect information from children under 13 must obtain verifiable parental consent prior to information collection and must institute specific policies for the protection of the children's PII.

A.6.5. Privacy Conclusion

Accessible transportation technologies have the potential to open worlds of access to people with disabilities; however, the data collected to allow the technologies to work can also lead to unintended consequences, such as a loss of privacy, data breach, and lack of trust in assistive technologies. Regardless of the technology in question, the considerations always come down to what information is collected, how it is maintained, how it is shared, and whether the individual has proper control over the updates to the data and notification of its use. Making sure that information is collected, used, and shared securely is the key to ensuring that the benefits of information use do not compromise privacy rights.

Accessible transportation technology institutions can ensure that these protections are built into systems by considering the FIPPs and other best practices from day one of the planning process. These accessible transportation technologies are constantly changing and advancing and, at the end of the day, ATTRI stakeholders will only use technologies that they feel they can trust, so ensuring that information is protected is both best for the public and for the institution designing and implementing transportation technologies. For the most part, because ATTRI is a research initiative as opposed to a technology manufacturer or regulatory body, it may not be actively engaged in ensuring that privacy protections are input into and upheld by accessible transportation technologies. However, ATTRI will need to identify where there are gaps in privacy and data protection and step in as participants and advocates to ensure that stakeholder privacy rights are upheld to the standards ATTRI believes are appropriate.

A.7. Potential Agenda Areas

The evaluations of the scenarios explored three common themes (*funding* for development, deployment and support, *channels to increase data availability*, *liability* of technology developers and providers) that can impact the mobility of people with disabilities. Technologies currently available to assist people with disabilities and those that are being developed face institutional and policy issues before they can be fully deployed. In this section, the evaluations contextualize the issues identified and assessed in Chapter Chapter 2 in the lives of people with disabilities. The main institutional and policy issues in the four scenarios include funding, limitations on providing accurate information, and who is liable if an accident occurs while using the technology.

A primary issue across all of the scenarios was the availability of funding. Areas for funding support include:

- Installation of infrastructure to enable technology deployment
- Data collection for existing technologies (e.g., visual and audio instructions)
- Purchase of equipment (e.g., autonomous shuttles, assistive devices)
- Development of new technologies
- Annual operation and maintenance of systems and programs
- Support for people with limited incomes (e.g., subsidized TNCs)

- Methods for using universal design to enhance accessibility within other services and products
- Conducting pilot studies and assisting small market deployment of new technologies, including
 - navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding
 - transit and wayfinding apps, and share static and real-time transit data
 - ICT to aid in paratransit usage

The primary concerns with the first three scenarios (Wayfinding and Navigation; Pre-trip Concierge, Visualization, and Wayfinding; and Safe Intersection Crossing) were funding support for the technologies and limited data availability. While all of the scenarios were located in urban areas, lack of neighborhood level data may be a limitation to the use of existing technologies by people with disabilities. Limited data would be expected to be a greater limitation for people living in suburban or rural areas. ATTRI may adopt creative, cost-effective support programs such as channeling publicly funded data through policy and regulation and incentives to populate valuable data bases.

Concern about liability for the risks necessarily taken by developers and providers on the forefront of technology is widespread throughout these scenarios. The liability issue is of particular concern with automation and robotics because there is a greater chance that a failure of the technology could result in injury or loss of life - not only for the person using the technology, but also the larger community. The range of potential actions to address this issue includes:

- guidance on standards of care in technology development and deployment, including care related to vulnerable populations
- guidance provided on liability and indemnification related issues
- support in funding pilot project is needed to test and refine any guidance that is developed
- potential limitations of liability (through statute or indemnification) for incubator enterprises; the limits on protected enterprises would be defined to nurture new and small businesses that served the desired markets by helping the businesses survive through the difficult early stages of development, and then grow and flourish
- potential limitation on utilization of ATTRI related development efforts in tort litigation (analogous to limitation on use of safety efforts in tort claims)

Tackling these issues will go a long way in addressing concerns of both developers and the communities that are looking to implement new technologies.

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Appendix B. Travel Impacts on Older Adults and Veterans with Disabilities

Travel impacts were evaluated for older adults and veterans with disabilities using the same methodology as the evaluation of travel impacts on persons with disabilities. This appendix summarizes the methodology, analysis, and results of the evaluation.

B.1. Market Size

We have estimated the market sizes of older adults and veterans with disabilities.

According to the 2009 National Household Travel Survey, the population aged 65 and over was approximately 38,870,000. That is about 13.7% of total population aged 5 and over.⁸⁴ Among adults aged 65 and over, about 33.3% of them reported having medical conditions that make travel difficult.¹⁰⁹

According to the 2010 Census, total population of veterans with disabilities was 5,465,191.¹¹⁰

B.2. Estimating the Impact on Older Adults Relative to General Public

Review of previous surveys and studies show that a significant portion of older adults have travel limiting disabilities. For that reason, mobility constraints of persons with disabilities are also common among older adults. In addition, the literature review also found that older adults are more dependent on personal vehicles than younger adults, more frequently as a passenger rather than a driver among older age groups, although the majority of older adults are drivers. Older adults often cease walking and using public transit before they cease driving. Also, walking is the second most common transportation mode among older adults, significantly higher than public transportation. Another characteristic about this group reported by a 2014 Pew Center study¹¹¹ is that adults over the age of 65 are significantly less likely to use advanced technology, which gives importance to actions that promotes technologies among older adults.

¹⁰⁹ Derivation of adults aged 65 and over with travel restrictive medical conditions is based on the analysis of 2009 NHTS data in the study "Understanding Older Drivers: An Examination of Medical Conditions, Medication Use, and Travel Behavior", conducted by AAA Foundation for Traffic Safety.

<https://www.aaafoundation.org/sites/default/files/Medication%20and%20Travel%20Behaviors%20--%20FINAL%20FTS%20FORMAT%20copy.pdf>

¹¹⁰ United States Census 2010. This is the source of all statistics from Census 2010, unless otherwise indicated.

<http://www.census.gov/2010census/>

¹¹¹ Smith, A. 2014, *Older Adults and Technology Use*, Pew Research Center. <http://www.pewinternet.org/2014/04/03/older-adults-and-technology-use/>

The 2009 National Household Travel Survey (NHTS) shows the prevalence of disability increases with successively older age group. Among adults aged 19 to 64, only 8% reported a medical condition that makes it difficult to travel. The percentages of adults reporting such conditions is 19% among those aged 65 to 74, 29% among those aged 75 to 84, and 50% among those aged 85 and over. See Table 11. The prevalence of disability makes the mobility constraints for persons with disabilities common among older adults as well. Those mobility constraints are (1) difficulty of walking due to poorly designed and/or maintained pedestrian environment, (2) difficulty to use a personal vehicle, (3) difficulty to use public transit and paratransit, and (4) unaffordability of available transportation options.

Table 11. Percent with a Travel-Limiting Disability by Age Group⁸⁵

Age Group	% Reported Travel Limiting Disability
19-64	8%
65-74	19%
75-84	29%
85+	50%

Transportation mode share data from the 2009 NHTS show that older adults are more dependent on personal vehicles than younger adults. See Table 12. The majority of older adults in the age group 65-84 are able to drive. For those aged 85 and over, percentage of drivers is lower but drivers still take up a significant portion of this age group. See Table 13. A European study found that older adults often cease walking or using public transportation before they are forced to cease driving. About a third of women over 80 cannot use walking as a means of transport, but many with a license can still drive.¹¹² These findings provide evidence that automobile is the most common and important mode of transportation for older adults.

Table 12. Transportation Mode Share by Age Group⁸⁵

Age Group	Auto	Transit	Bicycle	Walking
19-64	84.9	2.4	0.7	10.2
65-74	87.1	2.0	0.6	8.9
75-84	86.8	2.2	0.6	8.4
85+	85.1	2.9	0.1	9.7

Table 13. Percentage who Drive, by Age, Geography, and Gender⁸⁵

Age Group	Urban		Rural	
	Male	Female	Male	Female
19-64	93.2	89.6	95.6	95.0
65-74	91.7	82.0	96.2	82.0
75-84	86.3	67.0	90.9	74.9
85+	68.4	38.3	63.6	40.9

¹¹² Organisation for Economic Cooperation and Development, 2001, *Ageing and Transport: Mobility Needs and Safety Issues*. Paris, France: OECD.

It should be noted that walking is the second most common mode choice among older adults. The mode share of walking is much higher than public transportation.

In terms of use of technology, individuals over the age of 65 are significantly less likely to use advanced technology. Actions that promote advanced technologies among older adults, e.g. offering training on advanced technologies at locations and times convenient for older adults, would help reduce mobility barriers for older adults.

Based on the existing surveys and studies, actions that help older adults use a personal vehicle and walk would greatly benefit the group. Promotion and training of ATTRI technologies would likely be especially effective to facilitate deployment among older adults. Even though to a lesser extent, actions that reduce difficulty to use public transportation and to increase affordability of transportation would also help older adults travel.

The trip rate of older adults (aged 65 and over) is approximately 3.21, compared to 3.89 for those aged 5 to 64⁸⁵. That is a 21.1% difference in trip rate. Theoretically, the trip rate impact of a potential action item on older adults could range from 0% to 21.1%. An impact of 21.1% increase in trip rate implies the action could completely eliminate the mobility constraints for older adults, or in other words, they would have the same level of mobility as those aged 64 or younger.

Based on the findings on mobility constraints and travel behaviors of older adults, the team assessed the proportion of the potential 21.1% increase that might arise from the respective ATTRI actions. Based on the existing surveys and studies, actions that help older adults use a personal vehicle and walk would greatly benefit the group. Promotion and training of ATTRI technologies would likely be especially effective to facilitate deployment among older adults. Even though to a lesser extent, actions that reduce difficulty to use public transportation and to increase affordability of transportation would also help older adults travel.

Similar to the analysis of travel impact on persons with disabilities, Actions #1 and 8 are expected to have broad impacts on all transportation modes and a wide range of ATTRI technologies for older adults as well. These actions were ranked “high” in terms of their travel impacts relative to the other actions for older adults. Action #2, though expected to be very effective in promoting technologies requiring large investments in new infrastructure, would have little impact on technologies only relying on existing infrastructure. Action #4 directly addresses the unaffordability issue, but its impact on ATTRI technologies would be diluted if monetary subsidies are offered, or its impact would be limited to selected types of technologies if subsidies in kind are offered. Actions #5, 6, and 7 are expected to have broad impacts like Actions #1 and 8, but their levels of impacts are uncertain without further evidence. Compared to the two actions ranked “high”, Actions #2, 4, 5, 6, and 7 have noticeable limitations despite their merits. Therefore their impacts were ranked “medium” for older adults, and Actions #5, 6, and 7 were estimated to have slightly higher impacts than Actions #2 and 4 due to their broader impacts. Action #3 faces similar limitations that it would only benefit selected technologies for the funded pilot studies, and unlike Actions #2 and 4 that directly reduce the financial barriers for developers and consumers, the impact of Action #3 on market deployment is indirect (e.g. via market research). Therefore Action #3 was estimated to have relatively low impact on older adults.

The estimated impacts on trip rate were applied to Equation 1. The base trip rate is 3.21, i.e. the trip rate of older adults prior to implementation of any potential action. Table 14 summarizes the estimated trip rate impacts of the potential actions on older adults.

Table 14. Travel Impact Assessment of Potential Actions on Older Adults

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	Market Size (Pop. of Older Adults)	Base Trip Rate	Older Adults with Disabilities (1/3)				Older Adults without Disabilities (2/3)				Total Change in Annual Trips Made
						Ranking	Trip Rate Impact	Market Size (Pop. Of Older Adults with Disabilities)	Total Change in Annual Trips Made	Ranking	Trip Rate Impact	Market Size (Pop. of Older Adults with Disabilities)	Total Change in Annual Trips Made	
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	38,870,000	3.21	High	5%	12,956,667	759,033,925	None	0.00%	25,913,333	0	759,033,925
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for enabling technology development and deployment	38,870,000	3.21	Medium	2%	12,956,667	303,613,570	Medium	0.20%	25,913,333	60,722,714	364,336,284
3			Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding	38,870,000	3.21	Low	0.50%	12,956,667	75,903,393	Low	0.01%	25,913,333	3,036,136	78,939,528

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	Market Size (Pop. of Older Adults)	Base Trip Rate	Older Adults with Disabilities (1/3)				Older Adults without Disabilities (2/3)				Total Change in Annual Trips Made
						Ranking	Trip Rate Impact	Market Size (Pop. Of Older Adults with Disabilities)	Total Change in Annual Trips Made	Ranking	Trip Rate Impact	Market Size (Pop. of Older Adults with Disabilities)	Total Change in Annual Trips Made	
			<ul style="list-style-type: none"> transit and wayfinding apps, and share static and real-time transit data ICT to aid in paratransit usage first-mile and last-mile mobility solutions 											
4		Affordability of emerging products / services	Provide user subsidies, e.g. subsidized TNCs, smartphones	38,870,000	3.21	Medium	2%	12,956,667	303,613,570	None	0.00%	25,913,333	0	303,613,570
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers / service providers	Provide guidance on liability and indemnification issues	38,870,000	3.21	Medium	3%	12,956,667	455,420,355	Medium	0.02%	25,913,333	6,072,271	461,492,626
6			Potential limitation of liabilities for new business ventures	38,870,000	3.21	Medium	3%	12,956,667	455,420,355	Medium	0.02%	25,913,333	6,072,271	461,492,626
7			Potential limitation on utilization of ATTRI related development efforts in tort litigation	38,870,000	3.21	Medium	3%	12,956,667	455,420,355	Medium	0.02%	25,913,333	6,072,271	461,492,626
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	38,870,000	3.21	High	5%	12,956,667	759,033,925	Low	0.01%	25,913,333	3,036,136	762,070,061

Source: AECOM.

B.3. Estimating the Impact on Veterans with Disabilities Relative to General Public

Review of previous surveys and studies show that the demographics and travel behaviors of veterans with disabilities have noticeable differences than the general population with disabilities, despite their many similarities. Besides the mobility barriers common to all persons with disabilities, veterans with disabilities are more concentrated in rural areas compared to persons with disabilities in general, which implies they have limited public transportation and rely heavily on automobiles and their trip distance is longer on average than those residing in urban areas.

According to the Veterans Health Administration (VHA)¹¹³, 36% of Veteran Affairs patients with a service-connected disability are from rural and highly rural areas. That is substantially higher than persons with disabilities in general – 23.4%¹¹⁴ people with disabilities live in rural area in roughly the same period. Higher concentration of veterans with disabilities in rural areas means that for many veterans with disabilities, public transportation is not available. Even when public transportation is available, the longer travel distance in rural areas than in urban areas makes public transportation much less attractive than automobile. For veterans with disabilities residing in rural areas, technologies enabling them to drive and policies promoting affordability of such technologies would be especially effective in improving their mobility.

In 2010, Department of Veteran Affairs (VA) created the Veterans Transportation Service (VTS) to improve transportation for veterans to access VHA medical services. The VTS is a rideshare service that would benefit from new technologies that could improve efficiency in routing and scheduling, better coordination with existing transportation providers including TNCs.¹¹⁵

In general, actions to improve mobility for people with disabilities would benefit veterans with disabilities as well. In addition, existing surveys and studies suggest actions that enable veterans with disabilities to use personal vehicles, facilitate deployment of more efficient routing and scheduling technologies, and facilitate cooperation with TNCs would be especially effective for veterans with disabilities. For that reason, the potential actions were estimated to have similar travel impacts on an average veteran with disabilities as those for an average person with disabilities in general.

The estimated impacts on trip rate were applied to Equation 1. The base trip rate is 2.60, i.e. the trip rate of veterans with disabilities prior to implementation of any potential action. Table 15 summarizes the estimated trip rate impacts of the potential actions on veterans with disabilities.

¹¹³ Veterans Health Administration, 2014, *Fact Sheet – Information about the VHA Office of Rural Health and Rural Veterans*. http://www.ruralhealth.va.gov/docs/factsheets/ORH_General_FactSheet_2014.pdf

¹¹⁴ Derived based on data from the United States Census, American Community Survey 2009-2013 5-Year Estimates, <https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml>

¹¹⁵ Westat Inc. 2011, *Improving Mobility for Veterans*, Transit Cooperative Research Program J-6(74), Federal Transit Administration. http://onlinepubs.trb.org/onlinepubs/tcrp/tcrp_rrd_99.pdf

Table 15. Travel Impact Assessment of Potential Actions on Veterans with Disabilities

#	Action Category	Institutional, Policy, and Legal Issue	Action Item	Ranking	Trip Rate Impact	Market Size (Veterans with Disabilities)	Base Trip Rate	Total Change in Annual Trips Made
1	Awareness of Disability Needs	Lack of awareness of practical accessibility needs in product development and design	Enhance disability needs awareness and universal design methodology among private enterprises and policy makers by engaging the persons with disabilities community with the technology community	High	5%	5,465,191	2.60	259,323,313
2	Funding	Lack of market incentives for development and implementation of accessible technologies	Provide funding for enabling technology development and deployment	Medium	2%	5,465,191	2.60	103,729,325
3			Provide funding for conducting pilot studies and assisting small market deployment of new technologies, including: <ul style="list-style-type: none"> • navigation, in-station Bluetooth-based navigation system, and augmented reality wayfinding • transit and wayfinding apps, and share static and real-time transit data • ICT to aid in paratransit usage • first-mile and last-mile mobility solutions 	Low	0.5%	5,465,191	2.60	25,932,331
4			Affordability of emerging products/services	Medium	2.5%	5,465,191	2.60	129,661,656
5	Technology Risks	Unknown, potentially prohibitive liabilities of product developers/service providers	Provide guidance on liability and indemnification issues	Medium	3%	5,465,191	2.60	155,593,988
6			Potential limitation of liabilities for new business ventures	Medium	3%	5,465,191	2.60	155,593,988
7			Potential limitation on utilization of ATTRI related development efforts in tort litigation	Medium	3%	5,465,191	2.60	155,593,988
8	Change in Institutions and Policies	Existence of barriers in public right-of-way that hinder access to transportation	Emphasize existing regulations to eliminate barriers in the public right-of-way that hinder access to transportation	High	5%	5,465,191	2.60	259,323,313

Source: AECOM.

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Appendix C. Personal Identifiable Information (PII) Privacy and Governance Issues

Privacy has become a leading topic in the news in recent years, with breaches making headlines and discussions surrounding which institutions to trust with personal information becoming a topic of dinner table conversation. Unauthorized access, use, or disclosure of information can result in harm to individuals, leading to embarrassment, blackmail, identity theft, and even discrimination. Organizations, too, can be injured by breaches of PII, reducing public trust in the organization and creating potential legal liability and mitigation costs. Because of these harms, ATTRI institutions must carefully consider how to best protect the information they collect while still allowing use of information to advance the creation and use of accessible transportation technologies.

ATTRI focuses on research of development and implementation solutions for transformative technologies and systems, with the goal of improving the mobility of travelers with disabilities through the use of ITS and other advanced technologies. These transportation solutions have the opportunity to allow newfound mobility to ATTRI stakeholders and, in order to best serve this population, these solutions must not unduly compromise the privacy of their personal information. As such, the security and privacy of the personal information that accessible transportation technology companies and institutions collect is of the utmost importance.

Inherent in accessible transportation technologies are the privacy issues facing all technologies: how to protect and control the information provided by users and keep information out of the hands of those that intend to misuse it. While certain accessible technologies may raise new issues, the question remains the same: how can we protect information while still fully utilizing the tools available to us in the Information Age?

It has been postured that as the severity of an individual's disability increases, there is an increase in the willingness to sacrifice privacy for functionality.¹¹⁶ But should those with disabilities have to make this sacrifice? Are there laws and technologies that will protect this population and their personal information, or methods of recourse when privacy is not maintained?

Accessible transportation technologies have the potential to open worlds of access to people with disabilities; however, the data collected to allow the technologies to work can also lead to unintended consequences, such as a loss of privacy, data breach, and lack of use of the assistive technologies. Regardless of the technology in question, the considerations always come down to what information is

¹¹⁶ Scott Beach, Richard Schulz, Julie Downs, Judith Matthews, Bruce Barron & Katherine Seelman, *Disability, Age, and Informational Privacy Attitudes in Quality of Life Technology Applications: Results from a National Web Survey*, TRANSACTIONS ON ACCESSIBLE COMPUTING (TACCESS), SPECIAL ISSUE ON AGING AND INFORMATION TECHNOLOGIES, vol. 2(1) (2009).

collected, how it is maintained, how it is shared, and whether the individual has proper control over the updates to the data and notification of its use.

This appendix will explore the privacy framework in the United States; laws impacting the public and private sector, sector-specific information, states, and international privacy; applications of these frameworks and legal landscapes to emerging accessible transportation technology; and public expectations surrounding privacy in accessible transportation technology. This appendix will also discuss the privacy issues and considerations inherent in designing and implementing these technologies and controls to minimize privacy risks for ATTRI stakeholders using these technologies. Identification of vulnerabilities and risks from design onset will help ensure that private stakeholder information stays private and that ATTRI institutions maintain the public trust, enabling them to better serve the public.

C.1. Tenets of the United States Privacy Framework

C.1.1. Personally Identifiable Information (PII)

Privacy laws revolve around the protection, use, and sharing of PII. PII is defined as “(1) any information that can be used to distinguish or trace an individual’s identity, such as name, social security number, date and place of birth, mother’s maiden name, or biometric records; and (2) any other information that is linked or linkable to an individual, such as medical, educational, financial, and employment information.”¹¹⁷

In this definition, to “distinguish” means the ability to directly identify an individual, and includes data elements such as name, Social Security Number (SSN), and passport number. “Trace,” in contrast, means the ability to determine something about an individual’s activities or status, including data elements such as financial transactions or web search history. “Linked” information is information about, or related to, an individual that is associated with other information about that individual. Finally, “linkable” information is information about or related to an individual that has the possibility of being associated with other information about that individual. These elements encompass information that is not on its own identifiable, but can be made identifiable when associated with other information.

For the purposes of this study we are applying a broad definition of PII, to include those elements traditionally accepted as PII as well as some less-standard data points that are still linkable, such as GPS location information or medical information. As the collection, use, and sharing of these elements present privacy risks to their subjects, it is important to consider their protection when discussing emerging accessible transportation technologies.

¹¹⁷ National Institute of Standards and Technology (NIST), Special Publication (SP) 800-122, Guide to Protecting the Confidentiality of Personally Identifiable Information (PII) (2010). Some statutes and guidance also use the term “Information in Identifiable Form” or IIF. For the purposes of this study, the terms are interchangeable but we will use PII to ensure consistency throughout the document.

Additionally, some types of PII are considered of a higher level of sensitivity than others (this concept is referred to as the confidentiality impact level). This Sensitive PII (SPII) presents a greater level of potential harm to an individual if the information is inappropriately accessed, used, or disseminated.¹¹⁸ This may include SSNs and biometric information, such as fingerprints or iris scans. Other information might be deemed SPII because of the likelihood that release of the information could embarrass or otherwise harm the data subject, such as certain medical or financial situation, or other information of a highly-personal nature. Such an evaluation of the potential to embarrass may of course be a highly subjective thing, but certain types of information are nevertheless more likely to fall into this category.

SPII should be scrutinized more stringently, especially when deciding whether to collect the information, when putting information into a System of Records (SOR), drafting a System of Records Notice (SORN), and conducting Privacy Impact Assessments (PIAs) –discussed in Chapter C.2.1, below – and when deciding on security measures for protecting information.

Finally, Federal Agencies may define PII and SPII differently, as detailed in external or internal privacy policies. The way that these agencies define PII and SPII may affect how this information is treated and protected and circumstances under which the PII or SPII can be disclosed or shared.

C.1.2. Fair Information Practice Principles

The Fair Information Practice Principles (FIPPs)¹¹⁹ were first formulated by the Department of Health, Education, and Welfare (HEW) in 1973 and were later used as the basis of the Privacy Act of 1974, as amended. They have been used and adapted by Federal lawmakers and policymakers, as well as by states and international entities to apply privacy principles to systems, projects, programs, and the like.

The FIPPs provide the basis for privacy law and policy in the United States, including the laws discussed in Chapter C.2 below, and have guided discourse on privacy throughout the world. While the FIPPs are not law, but rather the basis behind laws, they still stand as best practices for organizations and should be regarded as such when designing systems and policies in the Federal government or private sector.¹²⁰

While there is some variation in the elements of the FIPPs, the basic elements, as formulated by HEW and additionally laid out in the Organisation for Economic Co-operation and Development (OECD) Guidelines,¹²¹ are: Transparency, Individual Participation, Purpose Specification, Data Minimization, Use

¹¹⁸ SPII is defined as “Personally Identifiable Information, which if lost, compromised, or disclosed without authorization, could result in substantial harm, embarrassment, inconvenience, or unfairness to an individual.” See Department of Homeland Security, Handbook for Safeguarding Sensitive Personally Identifiable Information, Mar. 2012, https://www.dhs.gov/sites/default/files/publications/privacy/Guidance/handbookforsafeguardingsensitivePII_march_2012_webversion.pdf.

¹¹⁹ The FIPPs are also known as the Fair Information Practices (FIPs) or principles.

¹²⁰ The FIPPs have also been used as a basis for the proposed Consumer Bill of Rights Act. The Consumer Bill of Rights was first introduced in the White House’s Consumer Data Privacy in a Networked World: A Framework for Protecting Privacy and Promoting in the Global Economic report in 2012. The report built off the FIPPs to create a framework for consumer privacy protection. Legislation was subsequently unveiled in 2015 to codify the report’s proposed protections, but has yet to be made into law. A copy of the Administration Discussion Draft of the Consumer Privacy Bill of Rights Act can be found at <https://www.whitehouse.gov/sites/default/files/omb/legislative/letters/cpbr-act-of-2015-discussion-draft.pdf>.

¹²¹ Organisation for Economic Co-operation and Development Guidelines Governing the Protection of Privacy and Transborder Data Flows of Personal Data (1980).

Limitation, Data Quality and Integrity, Security, and Accounting and Auditing. Each of these elements is defined and discussed below.¹²²

Transparency

Organizations must be transparent about information use and notify individuals when collecting, using, or sharing their PII. Part of organizational transparency includes providing consumers with privacy notices to inform them about information collection, use, and sharing. Such notices, in the interest of transparency, should be clear, reasonably short, free of legal jargon, and standardized to enable comprehension and allow comparison of privacy practices between institutions.

Transparency is important because it establishes trust between a data collector and data subject, allowing the individual to know and understand how their data will be used and to be able to properly consent to this use.

Individual Participation

Organizations should involve individuals in the collection and use of their information. Obtaining consent from the individual, where practical, prior to the collection, use, maintenance, and sharing of their information allows individuals to be actively participating in the way in which their data is managed. Organizations should provide mechanisms for individuals to view information collected about them and to correct or amend such information.

Two concepts related to Individual Participation are “opting-in” and “opting-out.” Opting-in means that an individual gives affirmative consent for an organization to use his or her information. Such consent may come in the form of a check box signifying consent or filling out a form and including PII. Opting-out, alternatively, means that consent is assumed absent the action of an individual signifying that he or she does not want PII collected. Opting-in is the preferred method of consent, as it gives individuals greater control and agency over collection of their information.

Another concept stemming from Individual Participation is access: Allowing consumers reasonable access to information about themselves that is held by an institution. The FTC, for example, has supported this principle in recommendations governing the practices of information brokers. This is also illustrated in HIPAA and HITECH’s provisions allowing consumers access to information that a Covered Entity or Business Associate holds about them, subject to some restrictions, as further explained in Chapter C.2.3.

Purpose Specification

Organizations should communicate the authority under which information is being collected and explain why the information is being collected prior to or concurrent with the data collection.

¹²² There are several versions of the FIPPs, promulgated by various national and international bodies, but they all contain the same common threads and hold a common consensus on the handling of PII. For this study, we have used the FIPPs as originally laid out by HEW.

Data Minimization

Organizations should only collect the minimum amount of data necessary to satisfy the purpose for which it is collected. Data should only be maintained for as long as is necessary to achieve the specified purpose.

It should also be noted here that retaining the minimum amount of data necessary and keeping data for only as long as necessary serves as a form of security measure in the case of breach, as the less information an organization holds, the less that can be compromised.

Use Limitation

Organizations should not use data for purposes other than those originally specified without first notifying and obtaining consent from the data subject. All sharing of PII should match the purposes for which the information was collected.

Data Quality and Integrity

Organizations should ensure that data collected is accurate, complete, timely, and relevant. This requires that organizations ensure that: PII is available when needed; PII is not improperly or inadvertently modified or destroyed; individuals who provide or modify PII cannot repudiate that action; PII is sufficiently accurate for the purposes needed; and outdated, unnecessary, irrelevant, incoherent, and inaccurate PII is removed from the organization's systems.

Security

Organizations should protect PII from loss, destruction, misuse, modification, and unintended or inappropriate disclosure with appropriate security safeguards. Security measures can include such measures as disaster preparedness and recovery plans; the use of firewalls and encryption; and guards and secured access at a server facility. A well-implemented security program should have administrative, physical, and technical safeguards in place. Such security measures should be commensurate with the sensitivity level of the PII.

Accountability and Auditing

Organizations should hold themselves accountable for complying with the FIPPs, provide training to employees and contractors who have access to PII, and audit the use of PII to ensure compliance with the FIPPs and all applicable laws and regulations.

C.1.3. Privacy by Design

Privacy by Design is the concept that organizations should build privacy directly into services and products at every stage in development to ensure privacy considerations from the outset. First conceptualized by the Information and Privacy Commissioner of Ontario and recognized by the Federal Trade Commission in its Consumer Privacy Framework,¹²³ as well as the European Commission, Privacy by Design consists of seven foundational principles:

¹²³ Federal Trade Commission, Protecting Consumer Privacy in an Era of Rapid Change: Recommendations for Businesses and Policymakers (2012), available at <https://www.ftc.gov/sites/default/files/documents/reports/federal-trade-commission-report-protecting-consumer-privacy-era-rapid-change-recommendations/120326privacyreport.pdf>.

1. Proactive not Reactive; Preventative not Remedial: Privacy by Design anticipates and prevents privacy-invasive events before they happen, rather than waiting for privacy risks to materialize.
2. Privacy as a Default Setting: No action is required by individuals to maintain their privacy; it is built into the system by default. This is similar to the concept of Individual Participation from the FIPPs, where opt-in information collection is favored over opt-out collection.
3. Privacy Embedded into Design: Privacy is an essential component of the core functionality being designed and delivered. The FTC has adopted this principle in its Consumer Privacy Framework, calling for companies to promote consumer privacy throughout the organization and at every stage of product development.
4. Full Functionality – Positive Sum, Not Zero-Sum: Privacy by Design seeks to accommodate all legitimate interests and objectives, rather than making unnecessary trade-offs.
5. End-to-End Security – Full Life Cycle Protection: Strong security measures are essential to privacy, from start to finish of the data life cycle. This is another principle that the FTC adopted in its Consumer Privacy Framework.
6. Visibility and Transparency – Keep It Open: Component parts and operations remain visible to users and providers alike. Stakeholders are assured that the business practice or technology is operating according to stated promises and objectives.
7. Respect for User Privacy – Keep It User-Centric: The interests of individuals are prioritized in the offerings.

In practice, institutions should incorporate substantive privacy protections into their practices, such as data security, reasonable collection limits, sound retention and disposal practices, and data accuracy. Institutions should also maintain comprehensive data management procedures throughout the life cycle of their products and services. Such privacy considerations are best done systematically to ensure that they are incorporated across the board and at every stage in the process. As advocated by the FTC Report, privacy-enhancing technologies (PETs) – such as encryption and anonymization tools – can be an additional means of implementing Privacy by Design protections throughout the life cycle.

Privacy by Design can also be implemented retroactively, such as into legacy systems, though arguably not with the ease or to the same benefit as when it is considered from Stage One. For example, security measures can be added or used to strengthen a current system to better protect the data. Similarly, institutions can post a Privacy Policy or start to allow users to opt-in to data collection on a current system. Some security solutions, such as adding two-factor authentication retroactively, may be fairly simple to implement and only cost the time it takes to implement the solution. Adding privacy protections retroactively, however, such as asking users to opt-in to information collection, may require significantly more effort and have a higher level of impact, requiring action on the part of all users. While adding privacy to current systems might result in increased expenses and may be difficult to implement, the costs associated with fines and loss of public trust that can result from a data breach will often outweigh those expenses.

Like the FIPPs, Privacy by Design is not mandatory, but rather should be implemented as a best practice to ensure that privacy is built into the system and consumer data is secured. While at times these considerations and certain necessary technologies for implementing Privacy by Design may result in higher costs or loss of some desired features, protecting consumer privacy and saving the institution from a potentially costly and reputation-damaging data breach has proven to be a worthwhile investment in the long term.

C.2. United States Legal Landscape

Chapter C.2 will explore significant laws in the United States (US) that impact privacy, touching on laws that affect public-sector government agencies; laws that affect specific information collections and/or collectors; laws that affect the private sector; a sampling of state laws; and civil causes of action. This is not an exclusive list of privacy laws in the US, but rather a survey of those with the largest impact on accessible transportation technology institutions and data.

C.2.1. Public-Sector Laws and Policies

Chapter C.2.1 provides a survey of Federal laws affecting privacy. These laws enumerate responsibilities for systems run by the Federal government, as indicated below, but can also impact the privacy responsibilities of entities receiving federal funding or those performing a service on behalf of the Federal government. Any agency, contractor, or grantee designing, producing, or maintaining accessible technologies on behalf of the Federal government are subject to the applicable provisions of the laws and policies mentioned below. As such, accessible transportation technology institutions that are part of the Federal government, receive Federal funding, or are performing a service on behalf of the Federal government must adhere to the requirements and rules as outlined below.

Additionally, the government has the ability to amend or modify requirements spelled out in laws by issuing memoranda; discussed below, for example, are three significant Office of Management and Budget (OMB) guidance documents that impact Federal privacy.

Finally, agencies themselves often issue policies and guidance that contain requirements and procedures that define how to implement the privacy requirements enumerated in laws and other guidance, and may require stricter standards for the protection of information. These many levels of requirements and best practices set out the Federal privacy landscape as it stands today.

Privacy Act of 1974¹²⁴

The Privacy Act of 1974 (Privacy Act) protects the privacy of individuals by establishing “Fair Information Practices” for the collection, maintenance, use, and dissemination of information by Federal agencies. For several years, the Privacy Act, along with its accompanying case law, was the most significant milestone in the history of the protection of the privacy of personal information held by the Federal Government. In the more recent past, subsequent laws, regulations, and guidance have built upon the principles first articulated in the Privacy Act.

The Privacy Act was first passed in a response to the executive branch’s liberal data collection practices in the mid-Twentieth Century. The Act seeks to regulate the government’s use of computerized databases of information about U.S. citizens and permanent legal residents. The law allows individuals certain rights regarding their information, embodied in the FIPPs; requires disclosure of matching programs where sharing of information between agencies may inhibit receipt of a government benefit¹²⁵;

¹²⁴ Privacy Act, 5 U.S.C. § 552a (1974)

¹²⁵ The Privacy Act was amended by the Computer Matching and Privacy Protection Act of 1988, requiring agencies that match data among agency systems granting financial benefits to publicly disclose that matching and to explain its scope. 5 U.S.C. § 552a(o) et seq. (1988).

and requires the government to publish SORNs in the Federal Register to serve as public notice prior to data being collected.

The Privacy Act also requires agencies to ensure the quality of PII, including ensuring accuracy (that the PII is sufficiently correct), timeliness (that the PII is sufficiently up-to-date), and completeness (that PII must be sufficiently available) of PII, as well as ensuring that appropriate security safeguards are implemented to protect the PII.

Other requirements of the Privacy Act include the following:

- Maintenance and retention of data, including the identification of a controlling National Archives and Records Administration (NARA) retention schedule;
- No usage of data outside of the Routine Use identified in the system's SORN or one of twelve use exceptions; and,
- Individual access and correction of information.

Individuals have redress rights if they feel their rights under the Privacy Act have been violated, first subject to agency procedures and then by taking the matter to court. Further, agencies can face civil and criminal penalties for the failure to comply with Privacy Act provisions.

E-Government Act of 2002¹²⁶

The E-Government Act of 2002 (E-Gov Act) was enacted to improve the use of information technology in the government and to promote the use of electronic government services by the public. Title II of the E-Government Act of 2002, Federal Management and Promotion of Electronic Government Services (Chapter 208), was enacted to ensure sufficient protection of PII in government information systems. Chapter 208 has two major requirements: Requiring Federal agencies to conduct privacy impact assessments (PIAs) prior to developing or procuring information technology systems that collect, maintain, or disseminate PII; and requiring agencies to maintain privacy policies on their websites.

The PIA provisions of the E-Gov Act mandate that federal agencies perform PIAs to identify and mitigate any privacy risks that arise from agency systems collecting information. Agencies are required to perform PIAs prior to developing, procuring, or modifying an information technology (IT) system that collects, maintains, or disseminates information about members of the public, or when the implementing new collection of identifiable information on ten or more members of the public. PIAs allow identification of privacy risks and risk mitigation to be assessed early in the system development process, and continually throughout a system's life cycle.

There are a number of triggers indicating the need for a new or revised PIA. As a best practice, some agencies use a short version of a PIA, known as a Privacy Threshold Analysis (PTA), to determine whether proposed information collection activities require a PIA.

Further, PIAs are often completed by commercial entities to ensure that all privacy risks are considered and mitigated where possible when designing and using systems. As such, it is a recommendation that all

¹²⁶ E-Government Act, 44 U.S.C. § 101 et seq. (2002).

organizations designing accessible transportation technologies fully consider their privacy risks by completing a Privacy Impact Assessment, whether or not they are required to by law.

Title II of the E-Gov Act also requires that agencies post website privacy policies. Agency privacy policies must address the following:

- What information is to be collected;
- Why the information is being collected;
- The intended use of the information by the agency;
- With whom the information will be shared;
- What notice or opportunities for consent are provided to individuals regarding the information that is collected and how that information is shared;
- How the information is secured; and,
- The rights of the individual under Chapter 552a of the Privacy Act and other laws relevant to the protection of the privacy of an individual.

Federal agencies must include a Machine-Readable Privacy Policy on agency websites the public uses. Also, Federal agencies' privacy policy notices must be consistent with the privacy policy requirements outlined in Chapter 552a of the Privacy Act.

Detailed guidance regarding implementation of the E-Gov Act has been laid out in OMB Memorandum M-03-22, discussed below.

OMB Circulars and Memoranda

OMB Circular A-130, Management of Federal Information Resources¹²⁷

OMB Circular A-130 (A-130) establishes government-wide policy for the management of Federal information resources. Appendix I of A-130 requires that heads of all Federal agencies to ensure compliance with the Privacy Act. A-130 requires that:

- All Federal information systems have security plans;
- Formal emergency response capabilities be instituted for Federal systems;
- Agencies appoint an individual to hold responsibility for operational security;
- Agencies issue Federal management and Fiscal Integrity Act reports to Congress on the security of their systems;
- Agencies develop security awareness training and made such training available to users and administrators of agency systems; and

¹²⁷ Office of Mgmt. & Budget, Circular A-130, Management of Federal Information Resources (2000). Proposed revisions to OMB Circular A-130, released on October 21, 2015, are currently under consideration and review. OMB also recently released a proposed OMB Circular A-108, which describes agency responsibilities for implementing the review, reporting, and publication requirements of the Privacy Act and related OMB policies. This draft circular includes a revised and expanded version of the guidance that currently exists in OMB Circular A-130 Appendix I, including guidance on SORNs; matching notices; Privacy Act implementation; annual matching activity reviews and reports; and agency website posting. The Draft A-108 was released on November 16, 2015 and is currently under consideration and review.

- Agencies review and revise system contingency plans.

Agencies must report to OMB on such matters as record-keeping practices, routine use disclosures, SORNs and SORN exemptions, and violations. Some agencies, additionally, have specific responsibilities under A-130, including the Department of Commerce, Office of Personnel Management, and the National Archives and Records Administration.

OMB Memorandum 03-22, OMB Guidance for Implementing Privacy Provisions¹²⁸

OMB Memorandum M-03-22 (M-03-22) provides agencies with implementation guidance for conducting PIAs and developing website privacy policies. M-03-22 applies to all Federal agencies and departments, including contractors and cross-agency initiatives that use websites and other information technology (IT) for interacting with the public. M-03-22 requires agencies to:

- Conduct PIAs;
- Make PIAs publicly available;
- Post privacy policies on agency websites;
- Translate privacy policies into a machine-readable format;
- Ensure that privacy responsibilities are properly executed for PII processed by IT; and,
- Annually report to OMB on M-03-22 compliance.

M-03-22 also lists a number of exceptions to the PIA requirement, including those for national security systems and for internal government operations, such as systems collecting information exclusively from Federal government personnel, including direct contractors. While PIAs are not required for these latter systems, it is still a best practice to conduct PIAs on all information systems that collect PII as a risk management technique.

M-03-22 does not specify the procedures for conducting PIAs but does list the content that PIAs should include: what PII is to be collected; why the PII is being collected; the intended uses of the PII, whether and with whom the PII will be shared; what opportunities individuals have to consent to PII collection and use; whether a SORN has been created for the particular system; and how the PII will be secured. M-03-22 also establishes that agencies should post their PIAs for the public's knowledge, either in the Federal Register, on an agency website, or both.

Finally, M-03-22 also outlines procedures for writing and posting website privacy policies, pursuant to the E-Gov Act. M-03-22 requires that agencies post or provide links to their website privacy policies on their principle website, on any website that provides a major point of entry onto their site, and on any websites that collect substantial PII. Policies must be in written in plain language and clearly labeled and accessible. Further, M-03-22 requires that agencies also provide a machine-readable version of their

¹²⁸ Office of Mgmt. & Budget, Memorandum 03-22, OMB Guidance for Implementing Privacy Provisions of the E-Government Act of 2002 (2003).

policy, automatically letting a visitor know whether an agency's policy matches the visitor's privacy preferences as indicated in his or her browser settings.¹²⁹

*OMB Memorandum 07-16, Safeguarding Against and Responding to the Breach of Personally Identifiable Information*¹³⁰

OMB Memorandum 07-16 (07-16) enforces the notion that the Federal government has a responsibility to protect PII that it collects. It requires all agencies to develop and implement data breach policies and includes a number of recommendations and requirements agencies must use in creating such policies. Appendix I of 07-16 created new requirements for agencies, including reviewing and reducing of PII volume; reducing of the use of social security numbers; security requirements. 07-16 also requires breach reporting to the United States Computer Emergency Readiness Team (US-CERT) regardless of whether a threat is potential or confirmed, as well as notification to affected individuals and/or the public.

*Executive Order 13636, Improving Critical Infrastructure Cybersecurity*¹³¹

Executive Order 13636 (EO 13636) was promulgated in 2013 to ensure the protection of the nation's critical infrastructure¹³² from growing cybersecurity threats. Because monitoring critical infrastructure can also open up entities to privacy risks, the EO 13636 also issued provisions to ensure protection of privacy and civil liberties. Included in those sectors identified as 'critical infrastructure' – and most pertinent to this study – is the Transportation Systems Sector, to which the Department of Homeland Security and the Department of Transportation are designated as Co-Sector-Specific Agencies.¹³³ The Transportation Systems Sector includes seven subsectors: Aviation; highway infrastructure and motor carrier; maritime transportation system; mass transit and passenger rail; pipeline systems; freight rail, and postal and shipping.

EO 13636 requires that agencies coordinate with privacy and civil liberties officials when carrying out the cybersecurity activities discussed in the Executive Order, and to base their privacy and civil liberties protections on the FIPPs and other policies, practices, and frameworks as applicable to individual agencies. EO 13636 also requires that agencies report to the Department of Homeland Security on activities impacting privacy and civil liberties on an annual basis in consultation with the Privacy and Civil Liberties Oversight Board (PCLOB) and OMB.

C.2.2. Private-Sector Laws and Policies

*Federal Trade Commission Act of 1914*¹³⁴

The Federal Trade Commission (FTC) Act established the FTC and was enacted to fight unfair methods of competition and unfair acts or practices that affect commerce. Chapter 5 of the FTC Act gives the FTC authority to prevent and protect against companies engaging in unfair or deceptive acts, including the

¹²⁹ Further discussion of machine-readable privacy policies can be found in Chapter 3.5.4 "Biometrics".

¹³⁰ Office of Mgmt. & Budget, Memorandum 07-16, Safeguarding Against and Responding to the Breach of Personally Identifiable Information (2007).

¹³¹ Executive Order 13636, *Improving Critical Infrastructure Cybersecurity* (2013).

¹³² "Critical infrastructure," as defined in EO 13636, means "systems and assets, whether physical or virtual, so vital to the United States that the incapacity or destruction of such systems and assets would have a debilitating impact on security, national economic security, national public health or safety, or any combination of those matters."

¹³³ Department of Homeland Security, Transportation Systems Sector, <http://www.dhs.gov/transportation-systems-sector> (Feb. 16, 2016).

¹³⁴ Federal Trade Commission Act, 15 U.S.C. §§ 41-58, as amended (1914).

misuse of consumer data. A company is acting deceptively under the terms of the FTC Act if it makes materially misleading statements or omissions about a matter, and such statements or omissions are likely to mislead reasonable consumers. A company engages in unfair acts or practices if its practices are likely to cause substantial injury to consumers that is neither reasonably avoidable by consumers nor outweighed by countervailing benefits to consumers or to competition.

Over the years, Chapter 5 of the FTC act has stood as the main form of recourse for consumers who feel that a private company has violated their privacy rights. There is no private cause of action, but the Commission has used its authority under Chapter 5 in cases where, for example, the Commission has reason to believe that a business made false or misleading claims about its privacy or data security procedures, or failed to employ reasonable security measures and, as a result, causes or is likely to cause substantial consumer injury.

It should be noted that, because of the press attention that such cases take, a majority of the cases brought under the FTC Act are settled out of court, and therefore there is a dearth of binding precedence FTC Act privacy and security jurisprudence.

Additionally, it can be argued that the FTC Act is a relatively weak law by which to fight those companies that violate privacy, as it can only go after companies that act unfairly or deceptively. The FTC can bring charges against a company for not following the practices outlined in their privacy policy or terms of service, for example, but can do nothing if no policy was in place or if the policy was truthful about having less-than-ideal privacy and security measures in place (which, in turn, also creates an incentive for a company to not have a very detailed privacy, or to have no privacy policy at all).¹³⁵

Weaknesses aside, the FTC has brought numerous cases against businesses because of alleged privacy and security-related violations, including a number of cases to protect consumers from companies' deceptive and unfair practices with regard to their health data and those that have failed to provide reasonable security for personal information.¹³⁶ As such, accessible technology companies must make sure to follow the practices promised in privacy policies and to adequately protect their data to avoid suit from the FTC.

C.2.3. Sector-Specific Laws

Health Insurance Portability and Accountability Act of 1996¹³⁷

The Health Insurance Portability and Accountability Act (HIPAA) of 1996 affects the health care and health insurance industry and contains provisions that govern how health care institutions, in both the government and private sectors, handle protected health information¹³⁸ (PHI), a subset of PII pertaining to health and healthcare information.

HIPAA was drafted as part of a movement to standardize medical claims data and the use of electronic medical transactions. The focus of the law was on simplifying the administration of health claims and how

¹³⁵ State Attorneys General are similarly able to bring charges against actors for unfair and deceptive trade practices on behalf of citizens in their respective states.

¹³⁶ See, for example, the FTC's recent cases against LabMD, Inc. and Wyndham Worldwide Corporation.

¹³⁷ Health Insurance Portability and Accountability Act, Public Law 104-191 (1996).

¹³⁸ PHI includes information pertaining to an individual's past, present, or future physical or mental health or condition; provision of health care to an individual; and past, present, or future payment for the provision of health care to an individual. It does not include health information that has been de-identified, a process further discussed in Chapter 3.5.4 "De-identification/Anonymization" below.

they were processed, with privacy and security measures added because of concerns with how this medical data would be used and protected. As such, only those entities that would be involved in this process – healthcare providers, health plans, and health clearinghouses – were included in the scope of the law. These entities are known collectively as Covered Entities, and can be either private or public organizations, such as hospitals, insurance companies, and health plans that encompass Medicare and Medicaid.

Other parties that do business on behalf of the covered entity, such as attorneys or service providers, are known as Business Associates (Bas). They also must comply with HIPAA's provisions and their security and privacy requirements must be defined in written Business Associate contracts. As discussed below, the HITECH Act expanded requirements for Business Associates, but the limited applicability to certain parties still remains.

Regulations published by the Department of Health and Human Services (HHS) in 2000, pursuant to HIPAA's provisions, establish standards for providing notice of how health information collected from users of a covered entity's services will be used and disclosed. They also grant certain rights to individuals, including the right to view one's health records and to request corrections or other amendments to those records. These provisions are known as the Privacy Rule and apply to both written and oral PHI. The Privacy Rule regulations seek to ensure that PHI is protected while also ensuring that it is available as needed for health care and to protect the public health.

HHS also promulgated the HIPAA Security Rule, which defines security standards for the protection of PHI. Covered entities are required to protect the confidentiality, availability, and integrity of PHI by implementing administrative, technical, and physical safeguards.

HIPAA is enforced by HHS and individual states, and non-compliance can result in fines and imprisonment. State can also enact laws that are more stringent than HIPAA; as such, covered entities and their business associates must familiarize themselves not only with HIPAA but also with the laws of states in which they conduct business.

Accessible transportation services would likely not fit into the definition of a covered entity and therefore HIPAA would be likely not apply to accessible transportation technology providers. Even applications that contain or collect health information typically do not fit under the narrow definition of a Covered Entity and therefore are not covered by HIPAA, as they are not providing a billable health care service and are receiving information directly from individuals rather than through a health care provider or health plan.

Similarly, it is unclear if any of the accessible transportation technology providers would be considered Business Associates, and this would likely need to be determined on a case-by-case basis, based on the technology and relationship, if any, to the Covered Entity. If these entities are not acting on behalf of, or providing a service to, a HIPAA Covered Entity, then they are also not subject to the HIPAA standards for Business Associates under the HITECH Act, discussed below.

Health Information Technology for Economic and Clinical Health Act of 2009¹³⁹

The Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009 was enacted as part of the American Recovery and Reinvestment Act of 2009 (ARRA). The ARRA was designed to

¹³⁹ Health Information Technology for Economic and Clinical Health Act, Public Law 111-5 (2009).

provide incentives related to health care information technology in general and specifically to encourage the adoption of electronic health record (EHR) systems among healthcare providers. Because of the expanded use and increased sharing of electronic PHI (ePHI), HITECH also strengthened and expanded on some privacy and security provisions first laid out in HIPAA.

First, the HITECH Act expanded HIPAA's enforcement provisions, including mandatory penalties for "willful neglect," increased civil penalties, and, while private citizens still do not have a cause of action against covered entities, HITECH now allows state Attorneys General to file suit on behalf of their constituents.

HITECH also increased data breach notification requirements for any unauthorized uses and disclosures of unsecured PHI. If the breach affects 500 or more patients, HHS must be notified as well and, under certain conditions, local media will be notified. Such notice is required whether the breach occurred internally or externally to the Covered Entity.

Covered Entities that have implemented an EHR system must give individuals the right to access their PHI in an electronic format, or designate a third party to receive their ePHI.

Finally – and most relevant to this study – HITECH expanded on HIPAA provisions that applied to Business Associates (Bas). Where privacy and security requirements were once imposed on Bas through contractual agreements, under the HITECH Act, Bas are directly required to comply with safeguards contained in HIPAA's Security Rule. As such, Bas such as EHR software vendors, attorneys, and other parties with contractual relationships with Covered Entities are now required to follow HIPAA's security requirements for PHI. Bas also must report data breaches to Covered Entities consistent with HIPAA and HITECH's notification requirement, and are subject to civil and criminal penalties under HIPAA for noncompliance.

If accessible technology stakeholders work directly with Covered Entities and are considered Business Associates, they will need to make sure to follow the changes as outlined in the HITECH Act. As discussed above, the BA relationship will depend on a number of factors, but can include EHR vendors and other suppliers engaged in designing technology and working with the Covered Entities on PHI data.

Genetic Information Nondiscrimination Act of 2008¹⁴⁰

The Genetic Information Nondiscrimination Act (GINA) was designed to prohibit the use of genetic information in health insurance and employment decisions. Under the Act, such "genetic information" can include information about an individual's genetic tests and the genetic tests of an individual's family members, as well as information about the manifestation of a disease or disorder in an individual's family members (i.e., family medical history).

The Coalition for Genetic Fairness (CGF), formed in 1997, was the primary non-governmental driver for Federal genetic non-discrimination legislation. The group was formed by several patient and civil rights groups to spearhead genetic nondiscrimination legislation on Capitol Hill. The Act allows for advancements in biomedical research and genetic diagnostic testing while allowing for the protection of individuals from misuse or discrimination based on genetic information.

¹⁴⁰ Genetic Information Nondiscrimination Act, Public Law 110-233 (2008).

Title I of GINA prohibits group health plans and health insurers from denying coverage to a healthy individual or charging that person higher premiums based solely on a genetic predisposition to developing a disease in the future. Health insurers also may not request or require covered individuals or their family members to undergo genetic testing or to provide genetic information. There are two exceptions to Title I of GINA:

- Health insurers may request genetic information in the case that coverage of a particular claim would only be appropriate if there is a known genetic risk; and
- In the context of research, when working in collaboration with external research activities, health insurers may be request in writing – but not require – that an individual undergo genetic tests. Refusal to do so may not impact premium or enrollment status and the genetic information, if given, may only be used for research purposes.

The Title I regulations also modify HIPAA's Privacy Rule to clarify that genetic information is health information and prohibit the use and disclosure of genetic information by covered health plans for underwriting purposes.

Title II of GINA prohibits employers from using an individual's genetic information when making hiring, firing, job placement, or promotion decisions. Title II also prohibits workplace harassment based on genetic information and strictly limits the disclosure of genetic information. The Act also limits employer access to genetic information, subject to six exceptions:

- Inadvertent acquisition of genetic information not in violation of GINA, such as overhearing a conversation about an employee's family member's illness;
- Genetic information voluntarily obtained as part of health or genetic services, such as a workplace wellness program;
- Family medical history may be obtained as part of the certification process for Family and Medical Leave Act leave or a similar leave program;
- Genetic information may be acquired through commercially and publicly available documents, such as newspapers, as long as such acquisition is unintentional;
- Genetic information may be acquired through a genetic monitoring program that monitors toxic substances in the workplace; and
- Genetic information may be acquired by employers who engage in DNA testing for law enforcement purposes as a forensic lab or human remains identification.

Any accessible transportation technology companies that may also fall under GINAs scope must be sure to only collect genetic information when one of the enumerated exceptions apply, and to not use such genetic information for any prohibited purposes.

Electronic Communications Privacy Act of 1986¹⁴¹

The Electronic Communications Privacy Act (ECPA), an extension of the Wiretap Act, protects US citizens' electronic communications, including video, audio, text, and data, from government surveillance by requiring a court order for wiretaps and the interception of communications. ECPA also prohibits

¹⁴¹ Electronic Communications Privacy Act, 18 U.S.C. § 2510 (1986).

private-sector providers of electronic communications services, including Internet service providers and cellphone providers, from divulging message contents.

Title I of ECPA protects and prohibits the interception and disclosure of wire, oral, and electronic communications (such as email) while in transit and sets out the criteria for obtaining a search warrant. Title II protects communications held in electronic storage, such as a computer or phone, but only for 180 days. It also prohibits the use of devices used to record dialing, routing, addressing, and signaling information from wire or electronic communications without a search warrant.

Employers and providers of wire and electronic communication services, such as Internet service providers, can only divulge information or contents of communication if there is a valid court order to do so or a written certification from an authorized official that no warrant or court order is required.

Under ECPA, employers are generally prohibited from intercepting employee communications and accessing those communications without consent; however, many employers require that employees consent on a splash page prior to using company devices as a work-around to this prohibition.

The government is also prohibited from secretly listening in on the conversations of public citizens without a warrant under ECPA, though these provisions were weakened slightly by the USA-PATRIOT Act of 2001.¹⁴²

As applies to ATTRI stakeholders, accessible technology providers that function as providers of wire and electronic communication services must be aware of ECPA's protections of these communications and only divulge information in keeping with the requirements under the law.

Children's Online Privacy Protection Act of 1998¹⁴³

The Children's Online Privacy Protection Act of 1998 (COPPA) applies to private sector websites that are directed toward and collect personal information online from children under the age of 13. The Act also applies to websites and online services that are directed to a general audience but have actual knowledge that there are users under the age of 13. In 2000, OMB Memorandum 00-13, *Privacy Policies and Data Collection on Federal Web Sites*,¹⁴⁴ extended the provisions of COPPA to Federal websites.

Among its provisions, COPPA requires that applicable website owners post a privacy policy to their website and identifies the content that a Website operator must include in a privacy policy. Additionally, website owners must provide notice about information collection practices to parents; obtain verifiable consent from parents before collecting children's information; give parents choices prior to disclosing children's information to third parties; provide parents access to their child's information and right to delete information and opt out from further collection; and maintain the confidentiality, security, and integrity of personal information collected from children.

¹⁴² Uniting and Strengthening America by Providing Appropriate Tools Required to Intercept and Obstruct Terrorism Act of 2001, Public Law 107-56 (2001).

¹⁴³ Children's Online Privacy Protection Act, 15 U.S.C. §§ 6501-6506 (1998).

¹⁴⁴ Office of Mgmt. & Budget, Memorandum 00-13, Privacy Policies and Data Collection on Federal Websites (2000).

Accessible technology providers who cater to or knowingly collect information from children under 13 must obtain verifiable parental consent prior to information collection and must institute specific policies for the protection of the children's PII.

Americans with Disabilities Act of 1990¹⁴⁵

The Americans with Disabilities Act (ADA) of 1990 prohibits discrimination and ensures equal opportunity for persons with disabilities in employment, State and local government services, public accommodations, commercial facilities, and transportation. As regards to privacy, the ADA prohibits employers from asking job applicants about the existence, nature, or severity of a disability.

Additionally, medical records are confidential under the ADA. With limited exceptions, employers must keep confidential any medical information they learn about an applicant or employee. Information can be confidential even if it contains no medical diagnosis or treatment course, and even if it is not generated by a health care professional. For example, an employee's request for a reasonable accommodation would be considered medical information subject to the ADA's confidentiality requirements.

The ADA could come into relevancy when designing accessible technologies if employers would, either because of their relationship to the employee or otherwise, have access to disability information. Such information must be kept confidential and must be separated from other personnel files.

C.2.4. State Laws

Legal compliance in the United States is based both on Federal law, as discussed above, and also on state laws. Where a Federal law is in place that dictates privacy requirements, a state law may only make those requirements more stringent. In other words, Federal requirements act as a floor, but not a ceiling.

At this time, nearly every state has its own data breach law with differing requirements, and some have sector-specific requirements, such as those for identity theft or medical privacy, or information-specific laws, such as those for biometric data. This segmented approach mirrors that of the Federal legal landscape.

While capturing all of the differences between the state laws may be out of scope for this study, a discussion of state laws and their requirements highlights additional considerations for those designing accessible transportation technologies. California, for instance, has become a leading legislator in privacy laws, seeking to fill the gaps in Federal privacy legislation and to provide its citizens with greater protection of their PII.

Delaware, too, has become a state on the forefront of privacy legislation, recently enacting several laws to protect its citizens from privacy invasions. Delaware's new laws include the Delaware Online Privacy and Protection Act,¹⁴⁶ which requires websites and apps to disclose PII they collect and how they use this information; the Student Data Privacy Protection Act,¹⁴⁷ which protects student privacy and bans the sale of student data; the Victim Online Privacy Act,¹⁴⁸ which protects domestic violence survivors from having certain contact information posted online; and the Employee/Applicant Protection for Social Media Act,¹⁴⁹

¹⁴⁵ Americans with Disabilities Act, 42 U.S.C. § 12101 (1990)

¹⁴⁶ Del. Code tit. 6 § 1201C (2015).

¹⁴⁷ Del. Code tit. 14 § 8103 (2015).

¹⁴⁸ Del. Code tit. 11 § 941 (2015).

¹⁴⁹ Del. Code tit. 19 § 709A (2015).

which protects employees from employers requiring access to their social media accounts. Laws such as these give states the ability to protect their constituents where they see a gap in Federal protections and legislation.

Other state-specific legislation is discussed in Chapter C.5.4 regarding Location Privacy and Biometrics. Additionally, common law, as discussed in Chapter C.2.5 below, is also largely state based, and therefore causes of action can have very different elements and legal precedent.

Organizations designing accessible transportation technologies must be sure to consult state laws as well as Federal or international laws when designing and implementing technologies, as they may require different or greater privacy and security protections and non-compliance could result in fines or sanctions.

C.2.5. Common Law Causes of Action

There are additional causes of action that arise from the common law, or though jurisprudence from past court cases, rather from codified laws. These actions can be brought by an individual, such as an ATTRI stakeholder, against another person or institution.

Negligence

Negligence results from a failure to behave with the level of care that someone of ordinary prudence would have exercised under the same circumstances. This behavior can consist both of actions and by a failure to act. A finding of negligence requires that five elements be found: the existence of a legal duty to exercise reasonable care; a failure to exercise reasonable care; cause in fact of physical harm by the negligent conduct; physical harm in the form of actual damages, and a showing of harm that is within the scope of liability.¹⁵⁰

In order to succeed on a negligence claim, the defendant must owe the plaintiff some sort of a duty, and must neglect that duty. They also must prove injury as a result of that breached duty, which can be quite difficult to prove if the breach in question is a privacy breach. How does one quantify a loss of information, or the emotional distress or embarrassment that may result from a privacy breach? Because these things can often be quite difficult to prove, negligence cases brought as a result of privacy breach have tended to fail when brought to court. However, as the mere press from getting sued may result in reputational harm to an entity, accessible transportation technology institutions should strive to protect themselves from any chance of suit and protect information from unintentional breach, loss, or unintended disclosure.

Other Civil Actions

In addition to the laws mentioned above, there are a series of common law causes of action arising out of tort law that can be applied to privacy rights. These actions can be brought by an individual, such as an ATTRI stakeholder, against another person or institution. It should be noted that these causes of action are not usually successful and usually require egregious behavior or a remarkable fact pattern on behalf of the privacy violator to fulfill a burden of proof.

¹⁵⁰ Restatement (Second) of Torts § 282 (1965).

- Public Disclosure of Public Facts: Cause of action for one who publicly discloses a private matter that is “highly offensive to a reasonable person” and “is not of legitimate concern to the public.”¹⁵¹ This requires actions to be “outrageous.”
- Intrusion upon Seclusion: A remedy when one intrudes “upon the solitude or seclusion of another or his private affairs or concerns” if the intrusion is “highly offensive to a reasonable person.”¹⁵²
- False Light: Creates a cause of action when one publicly discloses a matter that places a person “in a false light” that is “highly offensive to a reasonable person.”¹⁵³
- Appropriation: A plaintiff has a remedy against one “who appropriates to his own use or benefit the name or likeness” of the plaintiff.¹⁵⁴ An example of would be the use of a false endorsement of a product or unconsented picture used in an advertisement, and is the most likely of these actions to win in court.
- Breach of Confidentiality: A remedy when a professional, such as a doctor, lawyer, or banker, divulges a patient or client’s confidential information.
- Infliction of Emotional Distress: A remedy when one “by extreme and outrageous conduct intentionally or recklessly causes severe emotional distress to another.”¹⁵⁵

As stated above, these causes of action are not used often to assert privacy rights and are not often successful, however should be noted when considering privacy implications of emerging technologies.

C.3. International Law and Policy

For the purposes of this study, we will not dive too deeply into international laws and policies. However, below we introduce some international laws that are due discussion, both to get a global perspective on where US policies may eventually be and also to get an idea of the international laws that those designing accessible transportation technology might look towards for guidance or compliance.

The laws sampled below were chosen either because of their direct influence on the US as a party to the agreement or because of the law’s influence on US policy and industry, and are illustrative of some of the issues raised when attempting to comply with the varied laws and protections of international jurisdictions. The EU’s Data Protection Directive, for example, illustrates some of the considerations with and complications of transferring data to international jurisdictions which can apply whenever a cross-border data transfer takes place.

¹⁵¹ Restatement (Second) of Torts § 652D (1965).

¹⁵² Restatement (Second) of Torts § 652B (1965).

¹⁵³ Restatement (Second) of Torts § 652E (1965).

¹⁵⁴ Restatement (Second) of Torts § 652C (1965).

¹⁵⁵ Restatement (Second) of Torts § 46 (1965).

C.3.1. European Union

The European Union (EU) has some of the most stringent privacy and data protection laws in the world. Because of their rule over a great number of nations, many of which are business and political partners of the United States, EU privacy laws play an important role in US privacy discourse. Unlike the United States' sectoral approach, as discussed above, the EU has a comprehensive model of privacy legislation, which provides an overarching legal framework for all member countries.

Article 8 of the European Convention on Human Rights¹⁵⁶

The European Convention on Human Rights, first drafted in 1950, is an international treaty designed to protect the rights of citizens of its member countries. The Convention is enforced by the European Court on Human Rights and allows any person who feels that his or her rights have been violated by a state party to take a case to the Court. Judgments finding violations are binding on the States concerned and they are obliged to execute them.

Article 8 of the Convention provides a right to respect for one's "private and family life, his home and his correspondence," subject to restrictions in accordance with law and necessary in a democratic society. The Article provides a right to be free from unlawful searches, but also provides a right to protection for "private and family life," which has been given a broad interpretation.

EU Data Protection Directive¹⁵⁷

The EU Data Protection Directive, passed in 1995, protects individuals with regard to the processing of personal data and protects the free movement of such data. The Directive provides an overarching legal structure to protect the fundamental rights and freedoms of EU citizens, in particular the right to privacy with respect to the processing of personal data.

The Directive imposes strict requirements on any person who collects or processes data pertaining to individuals. The general rule is not to allow any collection or use of personal data unless permitted by law. The Directive is based on the FIPPs, has a broad definition of "personal data," and applies to all sectors of industry and types of personal data. Key provisions impose restrictions on personal data processing, grant individuals right as "data subjects," and set forth procedural obligations, including breach notification to national authorities.

¹⁵⁶ European Convention on Human Rights, Council of Europe (1953).

¹⁵⁷ 95/46/EC, Directive of the European Parliament and the Council of 24 October 1995 on the Protection of Individuals with Regard to the Processing of Personal Data and on the Free Movement of Such Data, available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31995L0046:en:HTML>. EU Data Protection Directive will soon be replaced by the General Data Protection Regulation (GDPR). The GDPR is a regulation which intends to strengthen and unify data protection for individuals within the EU. It also addresses the export of personal data outside the EU, including to the United States, and therefore will have large effect on the export of data to and from the US once the regulations go into effect. The GDPR was adopted by the Council of the European Union and the European Parliament on April 8, 2016 and April 14, 2016, respectively, and will go into effect on May 25, 2018.

The Directive also formed the Article 29 Working Party, a group of data protection authorities that provide guidance on a wide range of data protection issues. The laws are enforced by national Data Protection Authorities of member states as well as under the data protection authority of the European Commission.

EU e-Privacy Directive¹⁵⁸

Given concerns about the rise of unsolicited commercial email, the European Commission enacted the EU e-Privacy Directive in 2002 to address a range of issues related to electronic communications.¹⁵⁹ The e-Privacy Directive was adopted to regulate the privacy and data protection issues inherent in online marketing practices. It extends controls on unsolicited marketing to all forms of electronic communications, including unsolicited email and text messages. Key provisions from the Directive include:

- Individuals must give opt-in consent prior to receiving email unless there is an existing customer relationship and the customer is able to opt-out.
- “Cookie” files and similar online identification mechanisms are required to be more transparent and individuals are able to refuse them.
- Individual subscribers have stronger rights to decide whether or not they want to be listed in subscriber directories. Subscribers must be given clear information about the directories and informed of any reverse search capabilities.
- Value-added services, including location-based advertising to mobile phones, are permitted, so long as subscribers have given their consent and are informed of the data processing implications.
- Member states have the authority to introduce provisions on the retention of traffic and location data for law enforcement purposes.

In 2009, the e-Privacy Directive was amended to require member states to pass legislation that gives users the right to opt-in before cookies are placed on their computers or devices.

EU-US Data Transfers

The Directive generally forbids the transfer of personal data to countries that lack “adequate” data protection, including the US. To navigate around this, the US Department of Commerce, in coordination with the European Commission, developed a “Safe Harbor” framework. Corporations that agreed to participate in the Safe Harbor promised to apply the FIPPs as set out in the Safe Harbor framework, which applied to personal data that is transferred from the EU to the US.

Then, in October 2015, the European Court of Justice ruled that the Safe Harbor regime was invalid as a result of an action brought by an Austrian privacy campaigner, Max Schrems, in relation to the export of

¹⁵⁸ 2002/58/EC, Directive of the European Parliament of the Council of 12 July 2002 Concerning the Processing of Personal Data and the Protection of Privacy in the Electronic Communications Sector, available at <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0058:en:HTML>.

¹⁵⁹ The e-Privacy Directive revised, renamed, and replaced the Telecommunications Directive of 1997.

subscriber's data by Facebook's European business to Facebook in the USA.¹⁶⁰ The US and European authorities have been working on a replacement version of the Safe Harbor, but in the meantime model contract clauses and binding corporate rules have been used as an alternative method of ensuring that data transferred from the EU to the US is protected.¹⁶¹

Model contracts contain standard contractual clauses agreed to by the EU and the Article 29 Working Party for the purposes of meeting the adequacy standards defined under the Directive. Standard contractual clauses in agreements defined by the EU and Article 29 Working Party include extensive data protection commitments and company liability requirements. These contractual agreements help to ensure that an organization can avoid enforcement actions and interruptions in global business dealings.

Binding corporate rules (BCRs) are legally binding internal corporate rules for transferring personal information within a corporate group, as established by the Article 29 Working Party. BCRs are typically used by corporations that operate in various different jurisdictions, and must be approved by the EU data protection authorities of the different states in which the corporation operates before they become effective.

C.3.2. Canada

Despite its geographic proximity to the US, Canada is closer in philosophy and approach to the European model of data protection. Privacy oversight in Canada is managed by Canadian federal, provincial, and territorial data protection commissioners (also known as "information and privacy commissioners" or "ombudsmen"), as well as by specific industries. The Canadian government officials hold broad oversight powers and enforcement abilities of the below laws, but as of 2011 do not rely on fines.

The Privacy Act of 1983¹⁶²

The Privacy Act of 1983 provides rules and obligations on Canadian federal government departments and agencies to limit the collection, use, and disclosure of personal information. It also provides individuals with the right to access and correct personal information under the control of the government. Canada's Privacy Act closely mirrors the FIPPs and, as such also has elements in common with the Privacy Act of the US.

The Personal Information Protection and Electronic Documents Act of 2000¹⁶³

The Personal Information Protection and Electronic Documents Act (PIPEDA) is Canada's comprehensive national private sector privacy legislation. PIPEDA was enacted with the intention to facilitate the use of electronic documents, but also to ensure the EU that the Canadian privacy law was stringent enough to protect the personal information of European citizens. The Act has two goals: (1) to

¹⁶⁰ Case C-362/14, Maximilian Schrems v. Data Protection Commissioner, 2015 E.C.R. 650.

¹⁶¹ On February 29, 2016, after two years of negotiations and obstacles, the U.S. Department of Congress released details of the EU-US Privacy Shield in hopes of a new adequacy finding by the European Commission. Notably, companies must self-certify that they agree to and will comply with the Privacy Shield Principles. The EU-US Privacy Shield is not yet in effect, and the agreement's text and details are still under negotiation. The text of the privacy shield is available at https://beta.commerce.gov/sites/commerce.gov/files/media/files/2016/eu_us_privacy_shield_full_text.pdf.

¹⁶² Privacy Act, R.S.C. 1985, c. P-21 (1983).

¹⁶³ Personal Information Protection and Electronic Disclosures Act, S.C. 2000, c. 5 (2000).

instill trust in electronic commerce and private sector transactions for Canadian citizens; and (2) to establish a level playing field where the same marketplace rules apply to all businesses.

PIPEDA applies to every organization with respect to personal information that the organization collects, uses, or discloses in the course of commercial activities. “Personal information” under PIPEDA, consists of identifiable information, but not business contact information. Commercial activities can include any transaction, act, or conduct that is commercial in character, including the selling, bartering, or leasing of donor, membership, or other fundraising lists.

Like Canada’s Privacy Act, PIPEDA’s principles are based off of the FIPPs, and require that organizations adhere to 10 standards regarding the information they collect. Organizations are prohibited from using personal information without the person’s consent except in particular situations, such as for law enforcement investigations and emergency situations. Similarly, an organization is prohibited from disclosing personal information without consent, except in particular situations, such as for debt collection, compliance with a law or court order, or for law enforcement or national security purposes.

The Office of the Information and Privacy Commissioner has broad enforcement powers over PIPEDA, including auditing, investigative, and prosecutorial powers. Individuals can also hold organizations liable for violations of PIPEDA, and may seek damages from violators.

C.3.3. United Nations Convention on the Rights of Persons with Disabilities¹⁶⁴

The United Nations (UN) Convention on the Rights of Persons with Disabilities is an international human rights treaty designed to protect the rights and dignity of people with disabilities. The Convention has served as the major catalyst in the global movement to view persons with disabilities as full and equal members of society, with equal human rights. It was adopted on December 13, 2006 during the 61st session of the General Assembly and came into force on May 3, 2008.

Article 22 of the Convention is entitled “Respect for Privacy” and states:

1. No persons with disabilities, regardless of place of residence or living arrangements, shall be subjected to arbitrary or unlawful interference with his or her privacy, family, home, or correspondence or other types of communication or to unlawful attacks on his or her honor and reputation. Persons with disabilities have the right to the protection of the law against such interference or attacks.
2. States Parties shall protect the privacy of personal, health, and rehabilitation information of persons with disabilities on an equal basis with others.

The Convention is monitored by the UN Committee on the Rights of Persons with Disabilities. It should be noted that the UN Convention on the Rights of Persons with Disability was signed by the United States but has not been ratified by the US Congress to date; however there is a push by those within and outside of government to do so every year.

¹⁶⁴ United Nations Convention on the Rights of People with Disabilities (Dec. 13, 2006), <http://www.un.org/disabilities/convention/conventionfull.shtml>.

C.4. Application of the Law to Technology

It is important to emphasize that information that may be particular to accessible transportation technologies, such as health information relating to a disability, is not any different than other types of PII. This information needs to be protected with the vigor of any sensitive PII data point, but there are no specialized requirements stemming from the fact that the information might relate back to a disability (unless the data point in case falls under one of the specific laws outlined above, which then might subject it to specialized requirements).

Additionally, while an institution might not currently operate in, or advertise to citizens of, a foreign jurisdiction, these laws still may affect how manufacturers of accessible transportation technology design their products and services. In order to make these products and services potentially usable and in compliance in foreign jurisdictions in the future, or to appeal to the desires or needs of foreign consumers, specific attention needs to be paid to the various laws of foreign jurisdictions. This concept can apply also apply domestically, where technologies might have to comply not only with Federal statutes, but also with state privacy and data protection laws. All of the possible laws must be considered when designing the technology to avoid compliance issues down the road.

Similarly, both public and private sector laws may intersect with a given technology because of the different players and jurisdictions involved. For example, a collaboration between an ATTRI institution and private entity may require an analysis of both private and public sector laws, as well as any privacy and data protection laws from specific states or countries in which this technology will be implemented.

Because of these issues, a holistic look at how the different laws, guidance, and policies might apply to technology of information use is necessary when designing and implementing accessible information technologies. We will dive deeper into some of the legal and policy implications involving privacy in specific accessible transportation technologies in Chapter C.5 below.

C.5. Emerging Accessible Technologies

This section applies the concepts and legal framework discussed above to several emerging technologies in the area of Internet of Things and robotics, specifically – connected and autonomous vehicles, applications, and wearable technology –, to illustrate the privacy issues and challenges faced when designing and implementing accessible technologies of all kinds. This section also discusses several other concepts and types of information that present unique challenges and require further analysis by ATTRI stakeholders when developing accessible transportation technologies.

C.5.1. Connected and Autonomous Vehicles

Despite the fact that connected and autonomous vehicles have the potential to provide autonomy and convenience, to solve current challenges, and to open up a world of transportation opportunities for ATTRI stakeholders, these technologies come with serious privacy and security – not to mention safety – considerations.

Connected vehicles are vehicles that are equipped with Internet access, and usually also with a wireless local area network. This allows vehicles to share Internet access with other devices both inside as well as outside the vehicle. Connected cars allow drivers and passengers to control the car's features and are

able to communicate externally via the Internet. This Internet connectivity can allow or simplify such tasks as music playing, using smartphone apps via a dashboard screen, navigation, roadside assistance, voice command, parking assistance, and engine control and car diagnosis.

Autonomous vehicles, in contrast, are vehicles that are capable of sensing their environment and navigating or performing other tasks, such as parking, without, or with little, human input. Autonomous vehicles detect surroundings using radar, lidar GPS, odometry, and computer vision. Automated vehicles, such as those studied in ATTRI's Automation and Robotics Research Area and those being designed by Google and CityMobil2, provide exciting opportunities to provide transportation services to ATTRI stakeholders and help solve certain problems with implementing accessible transportation technology, such as first-mile and last-mile transportation. These vehicles have amazing potential to allow ATTRI stakeholders, who previously could not drive vehicles for various reasons, increase mobility and independence.

Connected and autonomous vehicles can collect a litany of information, including information about GPS location, trips taken, and personal information, about drivers. Such information should only be collected when necessary to perform specific tasks. Additionally, such collection should follow the principle laid out in the FIPPs – including properly securing information using such methods as encryption – and any sharing of information with third parties should be minimized and align with practices outlined in privacy policies and terms of service.¹⁶⁵

White Hat researchers recently released a report detailing a vulnerability in Nissan Leaf vehicles, which they exploited after discovering that all that was needed to remotely access the vehicle's system was the car's Vehicle Information Number (VIN), which is visible from the outside of the vehicle under the front windshield.¹⁶⁶ Once inside the system, researchers were able to view information about times and distances of recent journeys and control certain utilities, such as the air conditioning and heated seats, even when the car was turned off. Vulnerabilities such as this could allow hackers to access information in the vehicle, such as trips traveled and locations visited, calls made, text messages sent, and other personal data.

Some of these safety features meant to provide help in an emergency can also unintentionally violate the privacy of their drivers. One unique but illustrative example: A Florida woman was recently arrested for drunk driving, and the thing that implicated her was none other than her car.¹⁶⁷ Cathy Bernstein's car had a safety feature that alerted responders when it detected a crash. In this case, the car led police right to an alleged hit-and-run driver.

While such a safety measure – alerting authorities to a crash where the driver may be unresponsive – has inarguable benefits, and while no one would sympathize with a driver who leaves the scene of a crash,

¹⁶⁵ Potential surveillance capabilities of automated and connected vehicles, including the possibility of these cars being used to collect information for advertising purposes and resultant effects on personal privacy, was discussed in a recent Atlantic article. See Adrienne LaFrance, *How Self-Driving Cars Will Threaten Privacy*, the Atlantic, Mar. 21, 2016, <http://www.theatlantic.com/technology/archive/2016/03/self-driving-cars-and-the-looming-privacy-apocalypse/474600/>.

¹⁶⁶ Leo Kelion, *Nissan Leaf Electric Cars Hack Vulnerability Disclosed*, BBC, Feb. 24, 2016, <http://www.bbc.com/news/technology-35642749>.

¹⁶⁷ Hayley Tsukayama, *This Smart Car Seems to Have Tattled on its Driver*, WASHINGTON POST, Dec. 7, 2015, https://www.washingtonpost.com/news/the-switch/wp/2015/12/07/this-smart-car-seems-to-have-tattled-on-its-driver/?tid=sm_tw.

such technologies do raise issues. Many of the new technologies in cars make it increasingly difficult for drivers to hide their location, and consumers often do not realize what information they are giving up when they use these new features in their cars.

It should be noted that security vulnerabilities inherent in new technology may also present a safety concerns to passengers of automated vehicles. As detailed in a now-famous 2015 *Wired* article, White Hat researchers have shown the ability to hack into a Jeep Cherokee's control systems, which enabled the hackers to remotely control the car's entertainment system, air conditioning, and windshield wipers, and even cutting power to the car's engine and breaks while traveling on a crowded freeway, all by exploiting a zero-day vulnerability.¹⁶⁸ Examples of hackers finding and exploiting security vulnerabilities in automated vehicles, such as this, illustrate the potential dangers of this technology – not only for privacy, but physical safety as well – and show the importance of building proper cybersecurity into these vehicles throughout the design process and life cycle.

Acknowledging the need for some sort of privacy and security standards, the automotive industry has also begun to self-govern, taking rulemaking into its own hands: The Alliance of Automobile Manufacturers and Association of Global Automakers, advocacy groups of leading car producers, combined efforts to introduce their Auto Privacy Principles in 2014, ensuring transparency and heightened protection for consumer information collected by member automobile manufacturers.¹⁶⁹ These principles apply to the collection, use, and sharing of covered information in association with vehicle technologies and services and are built on the FIPPs, FTC guidance, and the White House Consumer Privacy Bill of Rights. By agreeing to these principles, participating automobile manufacturers are committing to comply with the principles in all new vehicles, vehicle technology, and service subscriptions in the United States. By issuing these principles, the auto industry is illustrating that they understand the benefits of increased information collection by their automobiles but also the risks and increased protections that come with that information collection and, showing their commitment to ensure that sensitive consumer information is protected.

The National Highway Traffic Safety Administration (NHTSA) has also recognized innovation potential as well as the privacy and security risks involved with connected and autonomous vehicles.¹⁷⁰ The NHTSA has started a research initiative investigating the cybersecurity of these vehicles, recognizing that there will not be widespread public acceptance of these technologies unless security and safety are ensured. NHTSA established a new division within its organization named the Electronic Systems Safety Research, which is tasked with researching the safety, security, and reliability of connected and autonomous vehicles. The NHTSA also established an internal agency Electronics Council working group, which is responsible for collaborating with issues related to vehicle electronics, including cybersecurity, across the NHTSA's organization. The NHTSA has partnered with other government agencies, vehicle manufacturers, vehicle suppliers, and the public to research automotive cybersecurity,

¹⁶⁸ Andy Greenberg, *Hackers Remotely Kill a Jeep on the Highway – With Me in It*, *WIRED*, Jul. 21, 2015, <http://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/>. Following this article's publication, Chrysler issued a recall of 1.4 million Jeep Cherokees to fix a flaw in the car's programming. Such patches to vehicle software do not require car owner's to physically bring their car to be fixed; rather, software updates can be sent via a USB drive and installed through a port in the vehicle's dashboard. See Andy Greenberg, *After Jeep Hack, Chrysler Recalls 1.4M Vehicles for Bug Fix*, *WIRED*, Jul. 24, 2015, <http://www.wired.com/2015/07/jeep-hack-chrysler-recalls-1-4m-vehicles-bug-fix/>.

¹⁶⁹ Consumer Privacy Protection Principles: Privacy Principles for Vehicle Technologies and Services, Alliance of Automobile Manufacturers, Inc. and Association of Global Automakers, Inc. (2014). For more information, see the Alliance of Automobile Manufacturer's Automotive Privacy page, available at <http://www.autoalliance.org/auto-issues/automotive-privacy>.

¹⁷⁰ National Highway Traffic Safety Administration, *NHTSA and Vehicle Cybersecurity*, available at <http://www.nhtsa.gov/About+NHTSA/Speeches,+Press+Events+&+Testimonies/NHTSA+and+Vehicle+Cybersecurity>.

effective best practices, and new system solutions. These partnerships have led to the publication of four cybersecurity reports that describe the agency's initial work in the area. At the challenge of the NHTSA, the automotive industry also created an Information Sharing and Analysis Center (ISAC), which is a forum for public and private sector partners to share threat information and identify weaknesses in their products.

These and other efforts by the NHTSA showcase how important the agency is taking automotive cybersecurity and, indeed, what an essential issue security has become as these connected and autonomous vehicles continue to be developed and driven on our roadways.

C.5.2. Applications

Applications, or apps, are computer programs designed to perform coordinated functions, tasks or activities for the benefit of the user. For the purposes of this study, we will be discussing applications that can be found on today's smart phone or tablet devices, and used for a variety of functions – but most relevant to our purposes, for increasing the accessibility of transportation.

Applications often have capability to store personal information, and some ask users to fill out a user profile. Profiles can be used to set up preferences for the types of information or assistance desired, and users can fill out personal information, such as contact and demographic information, financial information, such as payment data, certain health information, and location information. Additionally, an application may collect this information over time, such as tracking a user's location information or purchase history and storing that information in the user's profile within the application.

For example, in a travel-assistance application, a user might provide his or her specific information to build a profile, including listing accessibility needs, which would allow for location-based services both locally and nationally. This profile could allow the application to alert relevant authorities in advance of a user's trip of required special accommodations, such as a wheelchair at the airport. This information could be stored in the user's profile and continuously used to provide this service for as long as the user would require and want it. Such an application collects not only contact information, but also health information related to the user's accessibility needs and location information in order to function. Such information collection is reasonable, and relates to the primary purpose of the application, but this information must only be used for this purpose unless a secondary use is otherwise explained and consented to by the end user. Applications also usually allow users to choose out their preferences, including consenting to or opting-out of certain information uses and disclosures.

Due to the possible breadth of information contained in the user's profile, this information may be highly sensitive and application makers should take special precautions to ensure that this information is protected. Any sharing of information must be minimized to protect user privacy and should be carefully outlined in privacy policies, terms of use, and data use agreements with any third parties.

A recent study researching the privacy implications of health apps found that many of these apps transmit sensitive medical information, including disease status and medication compliance, to third parties, such as data aggregators and advertising networks.¹⁷¹ The study looked at all available Android diabetes apps and collected and analyzed their privacy policies and permissions. Researchers found that over 80

¹⁷¹ Sarah R. Blenner, Melanie Kollmer, Adam J. Rouse, Nadia Daneshvar, Curry Williams, and Lori B. Andrews, Journal of the American Medical Association, *Privacy Policies of Android Diabetes Apps and Sharing of Health Information*, Mar. 8, 2016, available at <http://jama.jamanetwork.com/article.aspx?articleid=2499265>.

percent of the apps had no privacy policies, and that not all the provisions in the policies actually protected privacy. Additionally, over 80 percent of the applications collected user data and almost half shared user data. Another study done by the same researchers also found that sensitive information was routinely collected and shared with third parties. The study researchers noted that, while only Android diabetes apps were studied, these findings would apply to all health apps and potentially to all apps in general.

As noted by researchers in this study, app users must be careful when installing and using apps and consider the risks, since there are no Federal legal protections against the sale or disclosure of user medical information, unless outlined in the application's privacy policy (if one even exists).

Similarly, in 2013, the Privacy Rights Clearinghouse conducted a study of 43 popular health and fitness apps to test security and privacy.¹⁷² Researchers found that only 43% of free apps linked to a privacy policy and that many apps send unencrypted data, including PII, without user knowledge. Further, 83% of free applications that were analyzed store data locally on the user's device and none encrypted the stored data. Many of these apps also sent data to third-parties, including advertising services.

The study also found that paid apps presented the lowest privacy risk, which gives credence to the privacy adage "If you're not paying for something, you're not the consumer – you're the product." Companies that provide free services have to make money somehow, and they often do so by selling consumer data to advertisers.

The same can be true for applications made to accompany accessible transportation technology. Free applications may provide a service to the consumer, but if the application developer is a commercial entity, it has to make money somehow – and this can often happen by selling user information to third parties for advertising purposes.

Applications may also have access to other information in a user's mobile device, such as contacts, maps, or search history. Many applications, however, allow the user to opt-in to certain information collection, usually via privacy settings. Applications also may have pop-ups asking to track the device's location in order to enable certain features. All access to information outside the application's boundary should be explicitly consented to and limited to information required to fulfill the application's purpose and functions.

C.5.3. Wearable Technology

Wearable technologies, such as those studied in ATTRI's ITS and Assistive Technology research area, are clothing and accessories that incorporate computer and advanced electronic technologies. These devices are an example of the Internet of Things, objects embedded with electronics, software, sensors, and connectivity to enable objects to exchange data with a manufacturer, operator, and/or other connected device, without requiring human intervention. Wearable technologies can be used for a number of functions, including fitness tracking, specific health issue monitoring, navigation, and communication. This utility presents vast opportunities for accessible transportation technology institutions, but also creates privacy and security risks.

¹⁷² Linda Ackerman, Privacy Rights Clearinghouse, Mobile Health and Fitness Applications and Information Privacy (2013), available at <https://www.privacyrights.org/mobile-medical-apps-privacy-consumer-report.pdf>.

One area of wearable technology that has been studied in detail is fitness and activity trackers. These health trackers, such as those made by FitBit and Garmin, collect information about a user's health, including physical activity and vital signs, and can collect mass amounts of information about an individual's activity and physical health over time. This information can paint a vivid picture of a user's health, habits, and life, and is therefore highly sensitive. Such information is not immune to breach, as was shown earlier this year, when FitBit users' data was hacked.¹⁷³ Additionally, seemingly innocuous information, such as activity data has been shown to be more than appears on the surface; reports have shown that analysis of fitness data can uncover rather sensitive data about its subjects.¹⁷⁴

The FTC has also voiced concerns that data from health trackers will be sold by the tracking companies, such as Garmin, Nike, and FitBit, to advertisers.¹⁷⁵ The data collected by health trackers can paint a rich picture of the data subject's life, making this information highly valuable and creating an incentive for companies to sell this data.

C.5.4. Other Privacy Considerations in Accessible Technology

De-identification/Anonymization

De-identification and anonymization are important topics when considering the privacy risks of data use. Research has shown that, with just a few data points, it is possible to identify the subject of information. HIPAA guidance on de-identification estimates that the combination of date of birth, gender, and 5-digit zip code alone can uniquely identify over 50% of the residents in the United States.¹⁷⁶ The proven linkability of seemingly random information is why proper de-identification and anonymization is essential in protecting PII from unintended breach or disclosure.

De-identification is the process used to prevent a person's identity from being connected with information about that person. De-identification is commonly used to safeguard privacy of research participants, and some strategies for de-identification can include deleting or masking personal identifiers, such as name and social security number, or suppressing or aggregating quasi-identifiers, such as date of birth and zip code. Re-identification is the reverse process of de-identification, and involves defeating de-identification methods in order to identify individuals.

Anonymization, similarly, is a type of information sanitization where PII is removed or encrypted that that data subjects remain anonymous. Anonymization involves irreversibly severing identify of a data subject from a data set to prevent any future re-identification, even by a study organizer or other data collector. De-identification, alternatively, may include preserving some identifying information which could only be relinked by a trusted party in certain situations.

De-identification methods generally remove any identifying data from a data set. This allows the data to be used, for example, for statistical purposes, but removes many of the privacy risks inherent with using PII. Such data sets may have any identifying information, such as name, email, or phone number,

¹⁷³ Dan Mangan, *There's a Hack for That: Fitbit User Accounts Attacked*, CNBC (Jan. 8, 2016), available at <http://www.cnbc.com/2016/01/08/theres-a-hack-for-that-fitbit-user-accounts-attacked.html>.

¹⁷⁴ Kashmir Hill, *Fitbit Moves Quickly After Users' Sex Stats Exposed*, Forbes, Jul. 5, 2011, available at <http://www.forbes.com/sites/kashmirhill/2011/07/05/fitbit-moves-quickly-after-users-sex-stats-exposed/#381d27c879e7>.

¹⁷⁵ Dana Liebelson, *Are Fitbit, Nike, and Garmin Planning to Sell Your Personal Fitness Data?*, Mother Jones, Jan. 31, 2014, available at <http://www.motherjones.com/politics/2014/01/are-fitbit-nike-and-garmin-selling-your-personal-fitness-data>.

¹⁷⁶ Dept. of Health & Human Services, *Guidance Regarding Methods of De-identification of Protected Health Information in Accordance with the Health Insurance Portability and Accountability Act (HIPAA) Privacy Rule (2012)*, available at http://www.hhs.gov/sites/default/files/ocr/privacy/hipaa/understanding/coveredentities/De-identification/hhs_deid_guidance.pdf.

removed but keeps information that is not identifiable and may be useful in the aggregate. An example of this as it relates to accessible transportation technology may be the following: An application is created that tracks the GPS coordinates of users to provide a service. If the app makers would also like to use this data to track more generally where this app is being used – and to do so securely – they can strip identifiable information, including name, device identifiers, and information regarding destination of the individual more broadly. This information can then be combined with other users' information to track where users of this app are located without the privacy risks inherent in using PII.

De-identification is especially important for government agencies, businesses, and organizations that seek to use data for a secondary purpose or make data available outsiders. Some secondary uses of data can result in societal benefits, and de-identifications allows this to happen with no or minimal privacy risk to the data subject. For example, if PII is collected by an application primarily to help a seeing-impaired individual cross the street by alerting traffic signals, this information could be secondarily used to study how users of the application navigate around a city to identify areas in need of infrastructure improvement. This secondary use does not require identifying specific individuals, and, as such, identifying information can and should be removed to prevent unnecessary privacy intrusions and potential breach of information. By de-identifying data sets, information can be used for a secondary purpose to learn important information while alleviating privacy risks.

In a 2015 survey asking individuals who work in healthcare about their data management practices, nearly half of the respondents expressed concern with re-identifying health data, and approximately a quarter stated that they were worried about having adequate knowledge to maintain the data and how much solutions may cost.¹⁷⁷

There are several accepted standards for de-identifying information.¹⁷⁸ The first, and widely-regarded as the most stringent, was created as part of the HIPAA Privacy Rule and provides the standard for de-identification of PHI.¹⁷⁹ Under this standard, health information is not individually identifiable if it does not identify an individual and if the covered entity has no reasonable basis to believe that it can be used to identify an individual. The Privacy Rule also provides two methods by which health information can be designated as de-identified. Under the first, the “Expert Determination” method, PHI is no longer individually identifiable if an expert, using statistical principles, determines that there is very small risk that the information could be used, alone or in combination with other available information, to identify the subject of the information.

Under the second, known as “Safe Harbor,” information is considered de-identified if a series of 18 identifiers of the individual or relatives, employers, or household members of the individual, such as name, geographic subdivisions, all elements of dates, and telephone numbers, are removed from the

¹⁷⁷ The State of Data Sharing for Healthcare Analytics 2015-2016: Change, Challenges, and Choice, Privacy Analytics (2015).

¹⁷⁸ NIST also recently released an Internal/Interagency Report (IR) entitled De-Identification of Personal Information. This report summarizes two decades worth of de-identification research, discusses practices, and presents opportunities for future research. National Institute of Standards and Technology, NISTIR 8053, De-Identification of Personal Information, Oct. 2015, available at <http://nvlpubs.nist.gov/nistpubs/ir/2015/NIST.IR.8053.pdf>.

¹⁷⁹ Chapter 164.514(a) of the HIPAA Privacy Rule.

data and the covered entity does not have actual knowledge that the data could be used by itself or in combination with other information to identify the subject of the information.¹⁸⁰

While many ATTRI institutions may not necessarily be subject to the HIPAA Privacy Rule, the HIPAA de-identification standards still provide a proven method and best practice to safely de-identify information for secondary uses.¹⁸¹

The FTC has also released guidelines on de-identification, which are applicable to private companies. The FTC provides a pseudo-safe harbor, stating that data is not “reasonably linkable” when a company (1) takes reasonable measures to ensure that the data is de-identified; (2) publicly commits not to try to re-identify the data; and (3) contractually prohibits downstream recipients of the data from trying to re-identify the data.¹⁸² The key to this is the promise to not re-identify the data sets as, under the FTC’s Chapter 5 powers, any company that violates this promise is subject to enforcement for deceptive practices. This provides an incentive for companies to control internal process to make sure that the de-identified data stays de-identified.

Data Transfer and Receipt

Accessible transportation technology applications may be developed with the capability to push and pull information to and from other sources, such as third party applications, websites, or data repositories. These data sources may be loaded on the device itself; for example, the travel-assistance application discussed in Chapter C.5.2 may request access to a maps or geolocation application to perform tasks inherent to its purpose. Alternatively, third party data transfers can also be to and from another source entirely, such as a database of individuals that have registered for a transportation service.

There are special considerations when transferring data to and from an accessible transportation technology application. Data received from third parties should inherit the security controls (technical, administrative, and physical) used by the data source and be protected at a level commensurate with the level at which it was protected by the third party or higher. When an application transfers data to a third party, proper security controls should be written into data use agreements and contracts to ensure that the data remains protected and that users’ privacy is not at unnecessary risk. Applications should also outline any data sharing in their privacy policy and allow users to opt-in to data transfers, when possible. Additionally, applications should be sure to protect data while in transit through the use of encryption and other security controls.

Location Information

Location privacy has emerged as a significant privacy issue in recent years. While in the past, individuals could typically go into public and feel safe knowing that their location was not being tracked, with the proliferation of smartphones, connected vehicles, wearable devices, and other technologies, this is no longer the case. These technologies, studied by ATTRI as part of the Wayfinding and Navigation research area, have made it easier for individuals, including ATTRI stakeholders, to navigate their way

¹⁸⁰ An exclusive list of the 18 identifiers that are required to be removed under Safe Harbor can be found in § 164.514(b)(2) of the HIPAA Privacy Rule.

¹⁸¹ Some state laws also define de-identification standards and they too are generally sector-specific. Institutions should be aware of such state laws when determining which de-identification method to use.

¹⁸² Federal Trade Commission, Protecting Consumer Privacy in an Era of Rapid Change: Recommendations for Businesses and Policymakers (2012), available at <https://www.ftc.gov/sites/default/files/documents/reports/federal-trade-commission-report-protecting-consumer-privacy-era-rapid-change-recommendations/120326privacyreport.pdf>.

around cities, public buildings, and from Point A to Point B. However, research has shown that stored location information can be traceable back to the individual, even when anonymized, and therefore must be protected and only be used for limited purposes.

A 2013 study found that, even a few data points from a location-tracking cellphone are enough to identify most people, even when the data is anonymized and identifiers such as address and phone number are removed.¹⁸³ This is due to the fact that while most people have a predictable pattern to their everyday lives, and these exact mobility patterns are unique to every individual.

Such location data, while seemingly innocent, can provide sensitive information about a person's activities, associations, or beliefs if breached or misused. Location information may identify religious and political associations, as well as other information that an individual might not want made public, such as visits to an HIV/AIDS or reproductive clinic or meetings with ex-boyfriends or business rivals. And because cell phones and applications within them can track where an individual is throughout the day, this can give a very detailed illustration of who the individual is.¹⁸⁴ This ability to paint a detailed portrait of a person can prove lucrative to advertisers, creating an incentive for companies to amass and sometimes sell this information.

The Supreme Court of the United States recognized the sensitivity of location information in a 2012 case, in which it ruled that constant tracking of an individual's movements over time and the collection of private data from an individual's cell phone are privacy invasions subject to the Fourth Amendment freedom against unreasonable search and seizure.¹⁸⁵

Many location and navigation-enabled applications and services need this information in order to function properly and provide a service. Turning off location services functionality might not be a reasonable option. However, institutions should only collect location information when necessary for the proper function of their application or device, allow opting-out of providing location information where possible, and should protect this location information from mishandling or loss through stringent security practices. ATTRI stakeholders should protect themselves by reading a device or application's terms of service to make sure that information is not being sold or shared prior to using the technology and should adjust settings in their mobile devices to further protect their information.

In lieu of any Federal legislation protecting location information, some states have decided to enact their own laws. Utah, for example, passed the Electronic Device Location Amendments bill in 2014, which prohibits government entities from obtaining location information from or about an electronic device without a search warrant.¹⁸⁶ The law also prohibits the use, copying, or disclosure of location information concerning non-target devices that is collected incidental to an investigation (such as the incidental information collected when using Stingray devices). Finally, the law requires a warrant for access to content of communications, such as email or text messages, sent by electronic devices. Similarly, in

¹⁸³ Yves-Alexandre de Montjoye, Cesar A. Hidalgo, Michel Verleysen & Vincent D. Blondel, *Unique in the Crowd: The Privacy Bounds of Human Mobility*, NATURE, Oct. 1, 2012, available at <http://www.nature.com/articles/srep01376#affil-auth>.

¹⁸⁴ David Adler, founder of the Adler Law Group, recently discussed this topic at the RSA Conference in March 2016 in a session entitled "Where You Are is Who You Are: Legal Trends in Geolocation Privacy and Security." For more information, see Taylor Armerding, CIO, *RSA: Geolocation Shows Just How Dead Privacy Is*, Mar. 2, 2016, available at <http://www.cio.com/article/3040248/security/rsa-geolocation-shows-just-how-dead-privacy-is.html>.

¹⁸⁵ *United States v. Jones*, 132 S. Ct. 9445, 565 U.S. ____ (2012).

¹⁸⁶ Electronic Device Location Amendments, H.B. 128 Enrolled (Utah) (2014).

2015, New Hampshire enacted a strong location privacy law that requires a judicial warrant for access to cell phone location data.

Biometrics

Biometric information can be used to provide alternative means to identify individuals and may be used to solve certain challenges in the alternative transportation technology sphere. Using a fingerprint would, for example, erase the need for a sight- or cognitively-disabled individual to identify the correct card to use or money to pay the fare for public transportation. Use of biometrics may solve some of the challenges with today's transportation infrastructure, but such use of this information may come at a cost to individual privacy.

It is argued that certain health information, including biometrics, is of higher sensitivity than other information, such as financial information.¹⁸⁷ After all, while you can contact your bank for a new credit card in case of a breach, you can't change your fingerprint, iris, or facial features with any amount of ease. Because there is little recourse when breached, this information must be protected with the utmost security controls in place and destroyed when no longer in use.

Additionally, while there is no Federal laws protecting biometric information, several states, including Illinois and Texas, do have laws restricting the use of biometrics and several more states are considering similar legislation. The Illinois Biometric Information Privacy Act¹⁸⁸, for example, requires organizations to acquire consent prior to collecting a person's biometric data for commercial purposes, and has been used against major internet corporations such as Facebook, Shutterfly, and, most recently, Google.¹⁸⁹ Such laws show the growing attention being paid to the use of biometric data in the commercial sphere and accessible transportation technology institutions must heed to this sensitivity when designing systems or solutions that use biometric data.

Making the Privacy Policies and Other Related Documents or Privacy Tools Themselves Accessible

When designing privacy tools – such as privacy policies and terms of service, or profiles that allow users to adjust privacy settings – it is important to make sure that these features are accessible in and of themselves. This might entail ensuring that the language is understandable and free of legalese and confusing jargon, or allowing visually-impaired users a way to 'listen' to privacy policies or terms of service via a recording.

Universal design is the design of products and services to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design. This concept is very applicable to accessible technology in general – designing environments and products that are usable to individuals regardless of any physical disabilities – but it also applies when designing with privacy in mind.

¹⁸⁷ Oliver Munday, *Biometric Security Poses Huge Privacy Risks*, Scientific American, Jan. 1, 2014, <http://www.scientificamerican.com/article/biometric-security-poses-huge-privacy-risks/>.

¹⁸⁸ Illinois' Biometric Information Privacy Act, 740 ILCS 14 (2008).

¹⁸⁹ See Wendy Davis, *Google Accused of Violating Illinois Privacy Law by Compiling 'Faceprints'*, MediaPost, Mar. 3, 2016, available at <http://www.mediapost.com/publications/article/270341/google-accused-of-violating-illinois-privacy-law-b.html>.

There are also Federal legal requirements for making these technologies and privacy protections accessible: The 1998 Amendment to Chapter 508 of the Rehabilitation Act states that when a Federal agency is developing, procuring, maintaining, or using electronic and information technology (EIT), they are required to ensure individuals with disabilities (both members of the public and Federal employees) have access and the ability to utilize the data in a way that is comparable to how an individual without disabilities would access and utilize the data.¹⁹⁰ If this process would cause undue burden to the Federal agency, that agency is required to develop a comparable means to provide the access and ability to utilize the data. Chapter 508 requires any technology made available to the public must accommodate the needs of those with disabilities, including providing the blind or deaf with alternative means to use technologies that they otherwise might not be able to.

Those designing accessible transportation technologies need to provide a means for ATTRI stakeholders to understand how their information is being used, protected, and shared, their rights, and the implications of sharing their personal information. This may be accomplished by providing an alternate way to communicate with these individuals, or, in some instances, it may also mean engaging with a caregiver when possible and necessary to make sure that privacy rights are asserted and privacy risks communicated.¹⁹¹

Another accepted method of communicating privacy preferences and ensuring those preferences are upheld are machine-readable privacy policies (MRPP). MRPPs allow users to set their privacy settings on their browser, such as whether to allow cookies. Websites can 'read' these settings and adjust their information collecting and advertising practices accordingly. The E-Government Act of 2002¹⁹² requires agencies to maintain privacy policies on their websites, but also requires that the privacy policy be translated into a machine-readable format. OMB Memorandum 03-22¹⁹³ provides detailed implementation guidance to Federal agencies on how to implement this requirement and requires agencies to provide a machine-readable version of their privacy policy on their website that automatically lets a visitor know whether an agency's policy matches the visitor's privacy practices. Private sector institutions, too, are urged to set up MRPPs to allow for this functionality. MRPPs can allow ATTRI stakeholders to set preferences, or seek assistance in doing so, and protect themselves from certain online information collection practices.

When designing privacy protections and communicating privacy and security policies for accessible transportation technologies, institutions must make sure that such features are designed with the ATTRI stakeholder in mind, and allow alternative means for protecting information and communicating rights and preferences.

¹⁹⁰ Rehabilitation Act, 29 U.S.C. § 794(d) (1998).

¹⁹¹ Engaging with a caregiver might raise some privacy risks in and of itself. Institutions should ensure that the user consents to a caregiver acting in his or her capacity and only communicate the minimum information necessary to ensure not to put user information at greater risk.

¹⁹² E-Government Act, 44 U.S.C. § 101 et seq. (2002)

¹⁹³ Office of Mgmt. & Budget, Memorandum 03-22, OMB Guidance for Implementing Privacy Provisions of the E-Government Act of 2002 (2003).

C.6. Consumer Expectations

C.6.1. Expectations of Privacy

Privacy is a very individualized and subjective notion: Each stakeholder might have a different idea of what information they would feel comfortable sharing, what information they would like to be kept private, and uses of their information that would make them uncomfortable. Moreover, these notions are fluid and may change over time or depending on the situation. Because of this, it is impossible to paint the picture of expectations of privacy for all stakeholders. Considerations of privacy must be made at every step in the design and implementation process with this in mind.

Even where there is no legal obligation, the public still expects that their private data will be kept private, that uses of their data will align with reasons it was given in the first place, and that companies won't cross the line into uncomfortable territory (commonly known as the 'ick' factor).

This concept was illustrated in a 2012 New York Times article, which showed that even where information is collected and used within the confines of the law, certain uses of information can make customers uncomfortable enough to stop using a product or service.¹⁹⁴ The article explores how, through the use of predictive analytics, Target was able to take a massive amount of information that they had gathered in-house and purchased from other sources to determine when a customer is pregnant – early on in the pregnancy and before family might even know. This could lead to a large financial payout by allowing the retailer to serve adds to this customer that appeal to her changing needs and influence purchasing decisions, but also make the customer highly uncomfortable – enough so where they may choose to shop elsewhere.

The New York Times article highlights the fact that just because an entity *can* use the information in a certain way, that does not mean that they *should* – or that any short-term financial benefits may outweigh the long-term effects of consumers choosing not to use their service or product over fears that their data will be misused or used in a way that makes them uncomfortable.

ATTRI stakeholders will not use accessible transportation technologies if they fear the misuse of their information. As such, it is in the interest of the technology producer – be it a government or private entity – to attain and hold the public's trust, lest consumers choose not to use the product or service for fear of compromising their privacy.

C.6.2. Misunderstanding of HIPAA Scope

As discussed above, HIPAA is the major law protecting health information, but the law only applies to healthcare clearinghouses, healthcare providers, health plans, and their Business Associates. As such, where it is a possibility that some accessible technology would fall under the purview of HIPAA – for

¹⁹⁴ Charles Duhigg, *How Companies Learn Your Secrets*, New York Times, Feb. 16, 2012, www.nytimes.com/2012/02/19/magazine/shopping-habits.html.

example, if a healthcare insurer provides the accessible transportation technology – but the vast majority will not.

Despite this fact, many consumers are not aware of HIPAA's stringent scope and believe that HIPAA covers and protects all medical information.¹⁹⁵ Individuals may have a limited or incorrect understanding of when data about their health is protected by law, and when it is not. As individuals share health information with non-covered entities, they might not understand where the protections afforded by HIPAA begin and end. Because HIPAA can be generally understood to regulate health information, individuals may incorrectly think HIPAA provides standards for privacy and security of health information in all contexts where their health information is collected, shared, and used. Because of this, ATTRI stakeholders and their caregivers may be more apt to divulge medical information, thinking that it will be protected under this misinterpretation of HIPAA. Additionally, they may inadvertently consent to unanticipated sharing and use by those they have permitted to collect their health information.

Further, if consumers do contact the Office of Civil Rights at the Department of Health and Human Services, the office that is responsible for enforcing the Privacy and Security Rules of HIPAA, there is often very little they can do since these cases are out of their jurisdiction.¹⁹⁶

If HIPAA does not apply to a use or disclosure of information, the privacy and security misconduct may still be regulated by the Federal Trade Commission's consumer protection oversight authority. However, this oversight authority does not provide the same type of level of protections as HIPAA.

This gap in coverage for medical information has not gone unnoticed by Congress. A 2009 law directed the Department of Health and Human Services and the Federal Trade Commission to research and issue recommendations within a year on privacy and security requirements for entities handling health information that do not fall under the scope of HIPAA.¹⁹⁷ To date, these recommendations have not been issued. Until recommendations or laws protecting all individually identifiable health information are promulgated, this will remain a gap in protection – one which, all too often, the public does not understand.

C.7. Conclusion

As discussed throughout this section, privacy can be a balancing act between using and protecting information. But making sure that information is collected, used, and shared securely is the key to ensuring that the benefits of information use do not compromise privacy rights.

Accessible transportation technology stakeholders can ensure that these protections are built into systems by considering the FIPPs from day one of the planning process. These accessible transportation technologies are constantly changing and advancing and, at the end of the day, ATTRI stakeholders will

¹⁹⁵ This issue was discussed at length during the Federal Trade Commission Spring Privacy Series on Consumer Generated and Controlled Health Data, May 7, 2014. A transcript is available at https://www.ftc.gov/system/files/documents/public_events/195411/2014_05_07_consumer-generated-controlled-health-data-final-transcript.pdf. For further discussion about consumer misconceptions of the scope of HIPAA, see Charles Ornstein, *Federal Privacy Law Lags Far Behind Personal-Health Technologies*, Washington Post. Nov. 17, 2015, www.washingtonpost.com/news/to-your-health/wp/2015/11/17/federal-privacy-law-lags-far-behind-personal-health-technologies/.

¹⁹⁶ Charles Ornstein, *Federal Privacy Law Lags Far Behind Personal-Health Technologies*, Washington Post. Nov. 17, 2015, www.washingtonpost.com/news/to-your-health/wp/2015/11/17/federal-privacy-law-lags-far-behind-personal-health-technologies/.

¹⁹⁷ 42 USC § 17953(b) (2009).

only use technologies that they feel they can trust, so ensuring that information is protected is both best for the public and for the institution designing and implementing transportation technologies. For the most part, ATTRI may not be actively engaged in ensuring that privacy protections are input into and upheld by accessible transportation technologies. However, ATTRI will need to identify where there are gaps in privacy and data protection and step in as participants to ensure that stakeholder rights are upheld.

U.S. Department of Transportation
Federal Highway Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

Toll-Free “Help Line” 866-367-7487
www.its.dot.gov

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