



## **Self-Driving Cars:**

**Mapping Access to a  
Technology Revolution**



**National Council on Disability**

November 2, 2015

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## National Council on Disability

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An independent federal agency making recommendations to the President and Congress to enhance the quality of life for all Americans with disabilities and their families.

November 2, 2015

President Barack Obama  
The White House  
1600 Pennsylvania Avenue, NW  
Washington, DC 20500

Dear Mr. President:

The National Council on Disability (NCD) is pleased to submit the enclosed report, *Self-Driving Cars: Mapping Access to a Technology Revolution*. For more than a decade, NCD has examined the positive impact of emerging technology on people with disabilities. NCD now envisions opportunities for people with disabilities to promote independence and economic opportunities if the marketplace can make emerging technology of personal transportation vehicles a reality.

The potential benefits of autonomous vehicles can hardly be more significant. Indeed, autonomous vehicles will change the world for everyone, but the most dramatic impact could be for people with disabilities and people who are aging, provided that their needs are understood and technology solutions are paired to meet such needs. Inaccessible transportation remains one of the biggest deterrents to employment and community involvement in the United States. Accordingly, autonomous vehicles have the potential to become an essential component of their independence, economic development, and well-being. Autonomous vehicles hold great promise to advance social inclusion by offering people with disabilities independent mobility to get to school, jobs, and all places that Americans go each day. They offer the possibility of ending the isolation that many people who are aging experience by keeping them connected with others and to activities that are often lost when we lose the ability to drive.

This report explores the emerging revolution in automobile technology and the promise it holds for people with disabilities, as well as the obstacles the disability community faces to realizing that promise. The report examines the current state of the technology, current approaches to regulation, and potential technological and policy barriers to full use by people with disabilities, and provides recommendations for preventing or eliminating those barriers, including model legislative language. Key recommendations include:

- All federal requests for proposals that provide funding for the research or development of autonomous vehicles or their components should include a requirement that respondents demonstrate that any resulting products incorporate accessibility for people with diverse disabilities. All technology products should be required to comply with Section 508 of the Rehabilitation Act.
- The Department of Transportation should develop a framework and set of national guidelines for autonomous vehicles licensing at the state level. To the extent possible, these guidelines should not impose limitations on people with disabilities. The guidelines should

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consider the new capabilities of autonomous vehicles and how people with disabilities can safely interact with and use these vehicles.

- Congress should pass legislation requiring full accessibility for all types of common and public use autonomous vehicles. Legislation should define a process that includes meetings with manufacturers, disability groups, and the National Highway Traffic Safety Administration. Relatedly, a disability advisory committee for automation should be created. The Access Board should be delegated the responsibility of developing standards. Existing rules, including Section 504 of the Rehabilitation Act and the Americans with Disabilities Act, should be interpreted to require accessible autonomous vehicles, including additional regulation by the Department of Justice, if needed.
- Congress should prohibit discrimination on the basis of disability by states or any other governmental authority in licensing for the use of autonomous vehicles. The remedy should be the withholding of federal highway funds to states that refuse to bring their licensing rules into compliance with this federal requirement. Such a provision would parallel the approach historically taken by the Federal Government with respect to the legal drinking age.

Adopting the recommendations in this report will ensure people with disabilities benefit from and realize the freedom of fully autonomous vehicles.

NCD looks forward to working with the Administration, Congress, and the automobile industry to ensure that all people with disabilities benefit from these exciting and emerging technologies.



Respectfully,

Jeff Rosen  
Chairperson

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(The same letter of transmittal was sent to the President Pro Tempore of the U.S. Senate and the Speaker of the U.S. House of Representatives.)

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# ACKNOWLEDGMENTS

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# EXECUTIVE SUMMARY

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**S**elf-Driving Cars: Mapping Access to a Technology Revolution explores the emerging revolution in automobile technology and the promise it holds for people with disabilities, as well as the obstacles the disability community faces to realizing that promise. The report examines the current state of the technology, current approaches to regulation, and potential technological and policy barriers to full use by people with disabilities, and provides recommendations for preventing or eliminating those barriers, including model legislative language.

The potential benefits of autonomous vehicles (AVs) can hardly be more significant, and the buzz about this newsworthy topic in the media has created the impression that they are just around the corner. Although experts in the field across all sectors, whether government or industry, agree that self-driving cars will evolve through many stages, the fully autonomous vehicles needed by many people with disabilities are most likely to appear on our roads sometime between 2020 and 2035. Regardless of when AVs are available, it is essential that they be accessible to people with diverse disabilities from the outset.

Different levels of automation will pose unique challenges to people with disabilities, and each of these conditions needs to be explored. An in-depth exploration of different levels of automation and their impact on people with diverse

disabilities (e.g., physical, sensory, intellectual/developmental, cognitive) as well as veterans with disabilities and the aging population should be conducted.

Yet the disability community knows better than any other how being involved in planning from day one is critical to a successfully accessible product, regardless of how many years in the future it lies. Due to the fast-paced development of this technology and the proprietary nature of its engineering, little information has been shared. While research reveals that the industry and government are explicitly considering disability access, insufficient information is publicly available to assess how close designers and manufacturers are to ensuring access to this very promising technology. We recommend increased transparency and involvement of the disability community as this technology continues development.

The Administration and Congress have an opportunity and the power to guarantee that self-driving cars provide a more inclusive, economically stable, and independent life for people with disabilities.

## **Current State of Technology of Autonomous Vehicles**

The National Highway Traffic Safety Administration (NHTSA) of the U.S. Department of Transportation (DOT) established the

commonly accepted levels of automation that the path toward self-driving cars will take: Level 0 (no automation) through Level 4 (full self-driving automation). Level 4 automation will enable people with disabilities who are currently unable to obtain a driver's license to take advantage of AV technology.

This report reviews the types of technological AV systems under development, addresses their status, and charts the outlook for adoption in personal vehicles and public transit systems.

### **Current Federal and State Approaches to Regulation of Autonomous Vehicles**

While there has been a call from AV researchers and manufacturers for federal attention, Congress' involvement has been limited to two exploratory hearings on AV technology in the House and Senate.<sup>1</sup> NHTSA's 2013 "Preliminary Statement of Policy,"<sup>2</sup> which has been widely adopted by researchers and states, provides a much-needed framework to bring a common understanding and language of the types of AV automation.

Some states have been reluctant to move forward with legislation or regulations on AVs. To date, four states and the District of Columbia have adopted legislation that defines AVs, allows for their testing under certain conditions, and limits the liability of the original manufacturer of cars that have been converted to operate in autonomous mode by a third party. Many states have pending legislation and some have considered, but not adopted, legislation related to AVs.<sup>3</sup>

In 2013, Thomas Bamonte, the General Counsel at the North Texas Tollway Authority, expressed concern that public agencies responsible for infrastructure have not engaged in planning for AVs, with the exception of the

Florida Department of Transportation, which is sponsoring testing on Florida roads as well as research to inform future legislation and policymaking.<sup>4</sup>

Moreover, it appears that some local and state transit officials and politicians are already reluctant to expand conventional public transit, stating that self-driving cars will more effectively fill the gap, without cognizance of the long wait involved and other possible barriers to realization of this hope.

### **Potential Technological Barriers to the Independent Use of Autonomous Vehicles by People with Disabilities**

AVs present a tremendous opportunity to end exclusion and promote independence for anyone who presently cannot obtain a driver's license, but significant work remains to ensure that technological systems currently in development will enable independent use by people with disabilities. It is important that manufacturers and government agencies collaborate with stakeholders, such as the disability community, to ensure that these technologies are fully accessible and available to all.

### **Potential Policy and Societal Barriers to the Independent Use of Autonomous Vehicles by People with Disabilities**

There are nine areas where policy decisions can affect the use of AVs by people with disabilities. While some of these barriers only affect people with disabilities, all potential users share most of them:

#### ***Driver's Licensing***

Once Level 4 AVs (i.e., fully self-driving cars) are available, there is no reason for an occupant

to be licensed at all. In order for all people with disabilities, no matter where they reside, to benefit from the technology, licensing or operating requirements must be the same across all 50 states.

Currently, states set the rules for issuing driver's licenses, while NHTSA sets motor vehicle safety standards. Although NHTSA lacks legal authority to regulate state driver's licensing requirements for individuals, the agency works closely with states and the American Association of Motor Vehicle Administrators (AAMVA) on a broad range of behavioral issues, some of which relate directly to driver licensing. Examples include driver's licensing best practices and application of medical standards to drivers who are aging and individuals with disabilities. NHTSA also has been delegated responsibility to ensure that state driver's licensing policies and decisions comply with the Title II of the ADA and does so through compliance reviews and complaint investigations conducted by its Office of Civil Rights.

Because the current edifice anticipates a human driver, all standards and regulations must be revisited. Varying state licensing laws may prove to be problematic for AVs that cross state lines, and there has been consideration of national legislation that would preempt state law.<sup>5</sup> In 2014, through a grant from NHTSA, the Autonomous Vehicle Best Practices Working Group convened to develop a guide for best practices to assist states in regulating autonomous vehicles and the testing of drivers who will operate them.<sup>6</sup>

### ***Cost and Income Disparity Barriers***

While AVs will include technologies that are expensive today, trends suggest that manufacturers will want to produce and sell these vehicles in the future. This suggests that

there will be high-end and low-end models with affordability to some degree. Where AVs circulate in a closed loop, or where they are shared and individually summoned by the user, the per-trip charge will be the only cost to the user—much like how we pay for taxis and many other car services today.

### ***Attitudinal Barriers***

Though general public polls show Americans as uncertain about the safety of AVs, industry and technology experts expect the vehicles to be far safer than cars because most auto accidents are related to driver error. As state regulators develop new licensing rules, they should consider the new capabilities of AVs and how people with disabilities can safely interact with and use these vehicles, rather than continuing restrictions based on the capabilities of old technology. As required by Title II of the ADA, restrictions on AVs must be based on evidence of actual risk, not unsupported generalizations about the capabilities of people with disabilities.

### ***Liability***

AVs present many insurance and liability issues that are not unique to people with disabilities, but some of the issues will need to be resolved to facilitate people with disabilities using self-driving cars. Fortunately, as safety and automation enhancements appear on vehicles, insurers are responding with new policies. They are also looking forward to the day when the driver disappears from behind the wheel.<sup>7</sup>

### ***Privacy***

AVs may involve a significant exchange of data, and privacy is a key question in developing and regulating this technology. Two such concerns

are the availability of data about disability and health status to insurers and of user habits to marketers.

### **Ethical Considerations**

Ethical considerations abound in the frontier technology of AVs. For example, discussions are already underway about how AVs should be programmed to decide who should be injured if a crash is inevitable and no solution exists without harming someone.

Related to people with disabilities, it is unclear if the data exchanged by AVs will include information about the occupants. Such information could be used in ways influenced by prejudices in society today, including, but not limited to, prejudices about disability. NHTSA is aware of no data that could be collected or exchanged relating to a motor vehicle (AV or other) that would contain information about the potential disability of a vehicle's occupants. Nevertheless, the National Council on Disability (NCD) is concerned that the lives of people with disabilities or seniors may be devalued when these automated systems must, at lightning speed, calculate who should be injured. Accordingly, NCD recommends federal legislation that prohibits the collection or transmission of information about occupants in AVs.

### **Cybersecurity**

Policymakers are well aware that data-intensive AVs could be hacked to cause life-threatening accidents, and cybersecurity research is underway. Cybersecurity concerns must be addressed before self-driving cars are allowed on the road. At least one policymaker, however, thinks that the security of digital systems to be used in AVs is inadequate.<sup>8</sup>

### **Infrastructure**

Some experts believe that infrastructure changes—in roadways, signage, and so forth—will be necessary for reliable self-driving cars to evolve.

### **Vehicle-to-Vehicle Communications**

Vehicle-to-vehicle (V2V) communications can further strengthen the quality of information available to AVs to make judgments about their surroundings by supplementing onboard vehicle sensors with basic safety information from surrounding vehicles. The Federal Communications Commission (FCC) has reserved a portion of a currently reserved 5.9 gigahertz bandwidth for V2V communications.

### **Recommendations**

Adopting the recommendations in this report will ensure people with disabilities benefit from and realize the freedom of fully autonomous vehicles. The recommendations address AV accessibility; funding for research; uniformity of requirements across the 50 states that address nondiscrimination, privacy, and ethics; financing; and inclusion of disability access in future hearing testimony.

Key Recommendations include:

- All requests for proposals that provide federal funding for the research or development of AVs or their components should include a requirement that respondents demonstrate that any resulting products incorporate accessibility for people with diverse disabilities. All technology products should be required to comply with Section 508 of the Rehabilitation Act.
- The DOT should develop a framework and set of national guidelines for AV licensing at

the state level. To the extent possible, these guidelines should not impose limitations on people with disabilities. The guidelines should consider the new capabilities of AVs and how people with disabilities can safely interact with and use these vehicles.

- Congress should pass legislation requiring full accessibility for all types of common and public use AVs. Legislation should define a process that includes meetings with manufacturers, disability groups, and NHTSA. Relatedly, a disability advisory committee for automation should be created. The U.S. Access Board should be delegated the responsibility of developing standards. Existing rules, including Section

504 of the Rehabilitation Act and the Americans with Disabilities Act, should be interpreted to require accessible AVs, including additional regulation by the U.S. Department of Justice, if needed.

- Moreover, Congress should prohibit discrimination on the basis of disability by states or any other governmental authority in licensing for the use of AVs. The remedy should be the withholding of federal highway funds to states that refuse to bring their licensing rules into compliance with this federal requirement. Such a provision would parallel the approach historically taken by the Federal Government with respect to the legal drinking age.



And then when you look at the rest of the community that can't drive today—be it because they have a disability or because they've gotten older and they either don't trust themselves to drive or family members have that very difficult conversation about taking the keys away—enabling them to get around the community is really kind of a big deal.

*Chris Urmson, Director  
Self-Driving Cars, Google*

# INTRODUCTION

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One of science fiction's promised technologies—autonomous vehicles, also known as driverless cars or self-driving vehicles—are on the horizon. Quickly advancing AV technology is producing one of the most dramatic revolutions in transportation since we shifted from the horse-drawn buggy to the Model A Ford more than 100 years ago. At that time, we removed the horse from the driving team. This time, we are removing the driver, and by removing the driver, AV technology promises to provide people with disabilities greater independence.

Headlines such as “Nissan Expects to Market Self-Driving Cars by 2020”<sup>10</sup> and videos from Google with drivers who are blind have led us to believe that people who currently cannot obtain a driver's license will “be in the driver's seat” in five or so years. While AVs hold tremendous promise for people with disabilities, there is reluctant consensus among carmakers, technology companies, academics, and government agencies that fully autonomous vehicles (AVs that will not require human intervention while operating on the open road) may be decades away. In November 2014, Brad Stertz, a spokesperson for Audi, wrote in an email to the *New York Times*, “Fully autonomous driving is mostly a human generation away no matter who is making promises.”<sup>11</sup>

AVs will change the world for everyone, but the most dramatic impact could be for people with disabilities and people who are aging, provided that their needs are understood and technology solutions are paired to meet such needs. Inaccessible transportation remains one of the biggest deterrents to employment and community involvement in the United States. Accordingly, AVs can become an essential component of their independence, economic development, and well-being. AVs hold great potential to advance social inclusion by offering people with disabilities independent mobility to get to school, jobs, and all places that Americans go each day. They offer the possibility of ending the isolation that many people who are aging experience by keeping them connected with others and to activities that are often lost when we lose the ability to drive. It has the potential to create new and innovative solutions to first mile-last mile issues (how one gets to and from their connection to transit) that have hindered many with disabilities for a long time; it is also likely that AV can help convert some ADA paratransit rides to fixed-route public transportation.

These remarkable benefits will not come at once and will not occur without cooperation among federal and state governments, research institutions, and private industry. Benefits will not emerge if the technology develops

without universal accessibility for people with diverse disabilities, including intellectual and developmental, sensory, and physical disabilities. Accessibility must be infused in the research and development of AVs.

The data needs for those with disabilities should be further explored. Travelers with disabilities need in-depth accessibility information about points of interest and municipal infrastructure. An example of a data integration solution is a standardized user profile for a person with accessibility needs that allows for location-based services both locally and nationally. Based on the user profile, applications

can be developed to alert relevant authorities in advance that a user requires accommodations, such as a wheelchair at the airport.

The reality of fully autonomous vehicles that people with disabilities can use is in the works, it is gradual, and it enjoys the support of governments, researchers, technology companies, automakers, and the public. Congress, through its legislative and appropriation powers, has an opportunity to guarantee that AVs contribute to a more inclusive, economically stable, and independent life for people with disabilities.

# Chapter 1. Current State of Technology of Autonomous Vehicles

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The vision of driverless vehicles carrying people, including people with disabilities who cannot drive to their destinations, has captured our imaginations and media attention. All major carmakers, automotive technology companies, academic researchers, and Google are developing technology that will eventually lead to fully automated vehicles where we are occupants instead of drivers. In the ten years since the 2004 DARPA Grand Challenge,<sup>12</sup> AV technology has accelerated to the point that, in December 2014, Google introduced a prototype vehicle with no manual controls, and Delphi Automotive test-drove a fully automated Audi SQ5 from San Francisco to New York City in March 2015.

The media predicts that fully autonomous vehicles will be available in the next decade or so. Optimism abounds that the time is near for AVs usable by people presently unable to drive, but many experts in the field suggest caution. Steven Shladover, a research engineer at the Partners for Advanced Transportation Technology program at the University of California, Berkeley, has been researching automotive technology for 40 years. He wrote in 2012 that “Unfortunately, the vast majority of what is being written and said is naive, uninformed speculation that seriously underestimates the technical challenges that must be overcome before fully automated driving can become reality.”<sup>13</sup> More recently,

Shladover’s sentiments were echoed at the Transportation Research Board 2014 Automated Vehicle Symposium, as reported in the *MIT Technology Review*:

John Leonard, an MIT expert in autonomous driving who attended the conference, says that he and other academics find themselves constantly battling the assumption that all of the technology challenges associated with robotic cars have been solved, with only regulatory and legal issues remaining. “It’s hard to convey to the public how hard this is,” he says.<sup>14</sup>

At the same conference, 500 AV experts were asked when they would trust a fully robotic car to take their children to school. More than half responded 2030 at the very earliest, a fifth said not until 2040, and roughly 1 in 10 said never.<sup>15</sup>

Countering these longer-term predictions, manufacturers, such as Nissan, have announced

## Availability Predictions

Five hundred AV experts were asked when they would trust a fully robotic car to take their children to school. More than half said the year 2030 at the very earliest, a fifth said not until 2040, and roughly 1 in 10 said never.



that the technology for fully autonomous vehicles is rapidly evolving, and it expects to have technology in place by 2020; but vehicles are unlikely to be on the road until 2025. In March 2015, Nissan CEO Carlos Ghosn stated, “After we’ve introduced our autonomous technology comes driverless cars, but they’re in the long term in ten years plus.”<sup>16</sup> Regardless of when fully autonomous vehicles are available, it is important that they be fully accessible to people with diverse disabilities from the outset.

To bring a common understanding about the development and capabilities of autonomous vehicles, NHTSA developed categories along a continuum of automation. NHTSA’s Preliminary Statement of Policy Concerning Automated Vehicles<sup>17</sup> provides what have become well-adopted definitions of the different levels of vehicle automation. Increased autonomy and the resulting independence for people with disabilities who currently are barred from holding a driver’s license (Level 4) depends on better

technology than what is currently available on vehicles and in the public infrastructure. NHTSA’s levels of automation include:

**Level 0: No Automation.** The human driver is in complete control of all functions of the car.

**Level 1: Function-Specific Automation.** One or more functions are automated, but they work independently of each other. The driver is always in control but can turn on a function like cruise control or parking assist.

**Level 2: Combined-Function Automation.** There are at least two automated functions that are designed to work together. In Level 2 vehicles, the driver can cede control to an automated function; but the driver remains in overall control, must remain alert, and is expected to take over all functions at any time. For example, cruise control working with automated speed control to sense traffic flow.

**Level 3: Limited Self-Driving Automation.** Drivers can give full control over to the vehicle under certain traffic or environmental conditions. The driving functions are sufficiently automated so that the driver can safely engage in other activities and the car will signal the driver to reengage with adequate time to safely regain control.

**Level 4: Full Self-Driving Automation.** The AV can drive itself without a human driver. The driver will provide trip or navigation input but is not expected to be available to take control of the vehicle at any time during the trip.

Level 4 automation will make it possible for people with disabilities who are currently unable to obtain a driver’s license to take advantage of AV technology. Notably, hand controls, a common technology used by many drivers with physical disabilities, would not be needed in Level 4 vehicles but would still be needed in Level 0 through Level 3.

Many of the cars on the road today fall into Level 1, and at least one automaker has announced that it will have a Level 2 AV in the showroom by 2017.<sup>18</sup> Beyond the Level 2 AV, there are no firm projections for when more fully autonomous cars will be available to commercial transportation providers or consumers.

New and emerging technologies, increasingly sophisticated software, and algorithms that provide real-time processing of vast amounts of collected data are how AVs make their way on the road. AVs that have been undergoing testing on and off our roads by Google and carmakers over the past six years use a combination of technologies intended to complement each other to ensure safe driving. The technologies include:

- Global positioning systems (GPS), which use satellites to keep track of the AV's position.
- Light Detection and Ranging (LIDAR), which is the laser remote-sensing system seen on the roofs of test AVs. It uses spinning laser beams to create detailed "maps" of the vehicle's surroundings.
- Radar sensors that detect the location and speed of nearby vehicles.
- Ultrasound sensors that detect distance to nearby objects.
- Cameras that detect lane stripes, signs, stop lights, road signs, and other objects.
- V2V and vehicle-to-infrastructure (V2I) systems, which allow AVs to communicate with each other and with roadway structures.

Google and vehicle manufacturers such as General Motors appear to be committed to enhancing and developing new technologies that will result in Level 4 vehicles, and these companies are aware that it will take time. According to GM spokesperson Dan Flores,

## New and Emerging AV Technologies

- Global positioning systems use satellites to keep track of the AV's position.
- Light detection and ranging (LIDAR) uses spinning laser beams to create detailed "maps" of the vehicle's surroundings.
- Radar sensors detect the location and speed of nearby vehicles.
- Ultrasound sensors detect the distance to nearby objects.
- Cameras detect lane stripes, stop lights, road signs, and other objects.
- Vehicle-to-vehicle and vehicle-to-infrastructure systems allow AVs to communicate with each other and with roadway structures.

"We believe that one day there will be fully automated cars that drive themselves under all circumstances.... A lot of societal benefits are possible, but we're years away from achieving those benefits."<sup>19</sup> Regardless of when fully autonomous vehicles are available to the public, it is important that they be fully accessible to people with diverse disabilities from the beginning.

While personal use of self-driving cars by people with disabilities is likely years away, they may reap the benefits of AV technology sooner. Shladover says that it is possible to increase mobility by 2022 by applying AV technology to vehicles that use dedicated public rights of way, such as buses. The physical separation from the rest of the traffic allows the vehicles to be managed safely without human intervention.<sup>20</sup>

However, depending on the type of vehicle, people with disabilities may still require assistance in driverless public transit vehicles. For instance, wheelchair users may still need assistance securing their wheelchairs in an automated bus rapid transit system.

In fact, AV technology is already being used in four publicly operated wheelchair-accessible public transit systems around the world. Currently, public transit at West Virginia University; Masdar City, United Arab Emirates; Heathrow Airport, London; and Suncheon, South Korea, use guideways that are limited to their exclusive use. The driverless automatic user pods at Heathrow Airport are compliant with the UK Disability Discrimination Act, and by some

reports, with the Americans with Disabilities Act. According to reports, the pods provide access for wheelchair users, include hearing loops for people who are deaf or hard of hearing, and raised symbols on all controls for people who are blind or have low vision.<sup>21</sup>

Testing of systems that eschew guideways and instead employ an array of sensors, GPS, and pre-programmed routes to navigate streets (such as Navia's wheelchair-accessible electric autonomous shuttle) are being tested in Greenwich and Milton Keynes, England, and Singapore. The Dutch Parliament announced plans to start testing wheelchair-accessible, fully autonomous electric shuttles in the city of Wageningen by December 2015.<sup>22</sup>

## Levels of Vehicle Automation

**Level 0: No Automation.** The human driver is in complete control of all functions of the car.

**Level 1: Function-Specific Automation.** One or more functions are automated, but they work independently of each other. The driver is always in control but can turn on a function like cruise control or parking assist.

**Level 2: Combined-Function Automation.** There are at least two automated functions that are designed to work together. In Level 2 vehicles, the driver can cede control to an automated function; but the driver remains in overall control, must remain alert, and is expected to take over all functions at any time. For example, cruise control working with automated speed control to sense traffic flow.

**Level 3: Limited Self-Driving Automation.** Drivers can give full control over to the vehicle under certain traffic or environmental conditions. The driving functions are sufficiently automated so that the driver can safely engage in other activities and the car will signal the driver to reengage with adequate time to safely regain control.

**Level 4: Full Self-Driving Automation.** The AV can drive itself without a human driver. The driver will provide trip or navigation input but is not expected to be available to take control of the vehicle at any time during the trip.

## Chapter 2 Current Federal and State Approaches to Regulation of Autonomous Vehicles

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Federal and state approaches to regulation of autonomous vehicles are still in their infancy.

Congress has held two exploratory hearings on AVs. In May 2013, the Senate Committee on Commerce, Science, and Transportation convened “The Road Ahead: Advanced Vehicle Technology and Its Implications” to hear testimony from the automotive industry, researchers, and NHTSA on the safety benefits, potential risks, and policy implications from the development and implementation of advanced vehicle technologies.<sup>23</sup>

In November 2013, the Subcommittee on Highways and Transit of the House Committee on Transportation and Infrastructure also brought together experts from NHTSA and the automotive and academic sectors for its “Hearing on How Autonomous Vehicles Will Shape the Future of Surface Transportation.” The hearing examined the potential impacts of the technology on the transportation network as well as federal policies that may be necessary for their integration into the infrastructure system.<sup>24</sup>

In February 2015, after the release of their report “Hacking & Tracking: Security and Privacy Gaps Put American Drivers at Risk,” Senators Edward Markey and Richard Blumenthal announced that they would introduce legislation to establish federal standards for all new cars

with wireless technology that would protect them from malicious hacking and to protect drivers’ privacy.<sup>25</sup>

In May 2013, NHTSA issued a “Preliminary Statement of Policy,” which identifies areas needing data to establish safety regulations and recommends principles that states may wish to apply, such as ensuring that drivers understand how to operate a self-driving vehicle safely and regulating testing of self-driving vehicles. According to this statement, NHTSA “does not recommend that states authorize the operation of self-driving vehicles for purposes other than testing at this time.”<sup>26</sup>

According to Stanford University’s updated “Automated Driving: Legislative and Regulatory Action,” the District of Columbia and four states (Nevada, Florida, Michigan, and California) have passed laws regarding autonomous vehicles.<sup>27</sup> Bernard Soriano, Deputy Director of the California Department of Motor Vehicles, commented that the California and Nevada statutes relate to both testing and operations. The Nevada regulations are minimal, while California’s are “more exhaustive.” Soriano said that about two dozen states are debating allowing autonomous vehicles on their roadways but that “we don’t want a patchwork of regulations. We have NHTSA on our steering committee so they provide us their expertise. Potentially, the

California regulations could be a model for federal regulations.”<sup>28</sup>

Bryant Walker Smith, Affiliated Scholar at the Center for Internet and Society at Stanford Law School, wrote in 2013 that automated vehicles are probably legal in the United States because no law categorically prohibits automated driving. Smith disputes Soriano’s suggestion that the legality of allowing AVs is a matter for states to debate. He also points out that the four states with related statutes do not really legalize AVs, but rather, regulate these technologies.<sup>29</sup>

The RAND Corporation issued a 2014 report cataloguing how every state is addressing the issue of autonomous vehicles, including both current and pending legislation.<sup>30</sup>

Despite the enormous amount of AV research and development, media attention, and the consensus that AVs will have a significant impact on lives and infrastructure, Thomas Bamonte, General Counsel at the North Texas Tollway Authority, noted that the

agencies responsible for public infrastructure are paying little attention. He wrote, “Conspicuously absent from this list of the

forces driving the development of driverless-vehicle technology are infrastructure providers such as highway authorities. State departments of transportation are neither focused on nor invested in driverless-vehicle technology.”<sup>31</sup>

One exception is Florida. In 2014, the Florida Department of Transportation created the Florida Automated Vehicles (FAV) initiative to plan and prepare for the eventual introduction of AVs on the road. The FAV initiative develops research, sponsors pilot projects, and is creating awareness

## Congressional Hearings on AV to 2015

**May 2013**—Senate Committee on Commerce, Science, and Transportation, “The Road Ahead: Advanced Vehicle Technology and Its Implications”

**November 2013**—Subcommittee on Highways and Transit of the House Committee on Transportation and Infrastructure, “Hearing on How Autonomous Vehicles Will Shape the Future of Surface Transportation.”

of AV technologies. Florida currently hosts two AV urban testing sites in Orlando and Tampa. In 2015, FAV announced two research projects to explore the implications of AV on policy. The first project, conducted by the University of Florida, will

help policymakers and planners understand how metropolitan planning organizations will need to update long-range transportation plans, traffic operation

considerations, and alternative land-use scenarios. The second project has direct implications for people with disabilities and people who are aging: researchers at Florida State University will examine how AV technology could assist transportation-disadvantaged individuals to remain mobile.<sup>32</sup>

While AVs are certainly a boon to transportation for people with disabilities, they will not eradicate the need for mass transit. Unfortunately, the promise of AVs has become a talking point for opponents of public transit

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*While AVs are certainly a boon to transportation for people with disabilities, they will not eradicate the need for mass transit.*

## State Laws on AVs, 2015

**Adopted Legislation:** DC, CA, FL, MI, NV

**Pending Legislation:** CT, GA, HI, ID, IL, MD, MA, MO, NJ, NY, ND, OR, TN, UT

systems. *Fortune* magazine described this trend, including how one Florida state senator argued “that the entire idea of bus- or train-based public transit is on the verge of obsolescence. Instead, he [saw] a future in which autonomous vehicles ... solve the region’s transit problems.”<sup>33</sup> According to this logic, why put funding into public transit at all?

Then, in 2015, an article in the web publication Streetsblog SF reported:

The Sunnyvale City Council voted 4-3 ... to oppose dedicated bus lanes that could cut transit riders’ trip [lengths] nearly in half along ... El Camino Real, making bus trips almost as quick as driving. More than one council member said the city shouldn’t invest in transit because self-driving cars are going to make it irrelevant....

Some council members dismissed better bus service entirely as impractical and outdated, despite the repeated success of dozens of [bus] rapid bus projects worldwide, and pointed to self-driving vehicles as a more appropriate transit solution for Silicon Valley.

“Instead of getting involved in Bus Rapid Transit, let’s start thinking of new and

innovative ways that make travel better for everyone,” said Council member Davis. “I’m not against smart transportation, but smart transportation is not increased numbers of buses. World class transportation systems are not those that rely on traffic lights and roadways.”

“When cars are actually autonomous and speak to each other, they will be packed more densely on the roads, and they won’t be creating that congestion,” said Council member Whittum. “So the idea of spending huge amounts of money on concrete to do this, it’s not a futuristic 21st century idea, it’s actually a very 20th century idea.”

Not only are self-driving vehicles many years away from hitting the market, let alone saturating it, but even in a hypothetical future with autonomous vehicles, the geometric reality is that cars take up far more roadway space than buses, and the financial reality is that many people won’t use them.<sup>34</sup>

While AVs may significantly change the way we travel, avoiding important expenditures on public transit today would have a disproportional impact on the disability community, given their dependence on the public transit sector for a high proportion of their mobility.

Autonomous vehicles can also serve a positive role in public transit through, for example, public fleets of accessible autonomous vehicles. Additionally, people with disabilities as well as the public could continue to use buses, trains, or paratransit to reach and transfer to new closed loop AV systems.



## Chapter 3 Potential Technological Barriers to the Independent Use of Autonomous Vehicles by People with Disabilities

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[Self-driving car] technology can't be less good than today's traffic safety, and in the United States, there are 3.3 million vehicle-hours per fatal accident and 64,400 vehicle-hours per injury. Developing fully autonomous vehicles that can achieve similar traffic-safety levels is "not a hard problem, that's a *superhard* problem."<sup>35</sup>

*Steven Shladover, Research Engineer  
Partners for Advanced Transportation Technology, UC Berkeley*

Lack of personal independent mobility has resulted in the exclusion of people with disabilities from education, employment, and social life. Autonomous vehicles present a tremendous opportunity to end exclusion and promote independence for anyone who presently cannot obtain a driver's license. As Steve Mahan, the Director of the Santa Clara Valley Blind Center in California, told the BBC, "In America, getting a driver's license is a rite of passage. It represents being able, having the liberty to go where you want to go. Cars and car ownership are important parts of a sense of independence and personal power."<sup>36</sup>

Generally, the current technological barriers standing between the use of Level 4 AVs by people with disabilities who are unable to hold a driver's license are the same for people who can drive now. The technological "superhard problems" summarized below will have to be resolved before anyone, with or without a disability, enjoys a ride as a passive occupant in a driverless AV.

There is one critical and unique addition to the list of technical challenges that is of particular importance for people with disabilities—ensuring

that AV user interfaces, how we give to and receive information from our vehicles, are accessible to all people. Engineers can facilitate access for these systems by building interfaces that provide audio and visual access, not one or the other. As Marc Riccobono, President of the National Federation of the Blind said, "The average engineer thinks you just talk to the car and listen to the car to get information. That won't work for people who are deaf or hard of hearing."<sup>37</sup>

The technical challenges include:

- A. Accessibility and assistive technologies
- B. Limitations of sensors (cameras, LIDAR, radar, infrared, ultrasonic)
- C. GPS and other mapping-system accuracy
- D. Ultra-reliability and redundancy of software
- E. Equipment failure
- F. Software security

### **Accessibility and Assistive Technologies**

Advancing AV technology holds the key for independent use of vehicles by people who

cannot hold a driver's license. However, without explicit inclusion of accessibility in the development of AV technologies, the potential for opportunity wanes. During the early days of the Internet, and still today, accessibility for people with disabilities was not considered by web developers, and many people with disabilities experienced unnecessary obstacles to information (e.g., text that is inaccessible to screen reader software, lack of captions on audio content, keyboard-only navigation). Those obstacles diminish the opportunities available to people with disabilities that the Internet presents for people without disabilities. This is a lesson for AV researchers and engineers—the time is now to commit to and include accessibility. To guide their designs, AV developers can borrow from Web Accessibility in Mind's guide for building accessibility into websites:

- Awareness is the foundation to a commitment to accessibility.
- Leadership must express a commitment to accessibility.
- Policies and procedures must be in place that back up the commitment to accessibility and outline specific standards, procedures, and methods for monitoring compliance.
- Training and technical support on accessibility and assistive technologies must be available to researchers, designers, and engineers.<sup>38</sup>

The inclusion of accessibility in AV user interfaces is not limited to programming access for navigation or user controls for people with sensory or physical disabilities. AV systems must not conflict with the use of hand controls

(in Level 2 and 3 AVs), wheelchair ramps, lifts, or lockdown systems.

### **Limitations of Sensors (cameras, LIDAR, radar, infrared, ultrasonic)**

- Processing real-time data. Due to the variety of sensors in use on an AV, a great amount of raw data is being generated to build an accurate picture of the AV's surrounding environment. According to the RAND Corporation:

Different combinations of sensors offer different combinations of capabilities and redundancies at different price-points, and cost is a key constraint. While every additional sensor may contribute some degree of navigational assistance in a particular set of conditions, it also increases the physical and computational complexity and cost of the vehicle, and decreases the feasibility of its introduction in commercial vehicles.<sup>39</sup>

- Making sense of a quickly changing and dynamic environment.

For example, AVs must be able to detect, understand, and process information about other vehicles; other road users, such as pedestrians (e.g., tell the difference between a person waving at someone and a police officer waving traffic to the side), bicyclists, runaway pets, and wildlife; and random obstacles like mattresses that fall off the backs of trucks.

Sensors are not yet sophisticated enough to operate in weather conditions such as fog, snow, and severe storms.

## GPS and Other Mapping-System Accuracy

GPS systems, even when combined with complementary systems such as inertial navigation systems that engage when GPS positioning is lost, must be robust and accurate. Indeed, if the vehicle has “machine vision” that is equivalent to human vision (a large technological challenge on its own), then the GPS only needs to be able to provide street-level positioning, while the vehicle itself will use machine vision for precise positioning.

The AV will also have the advantage of digital information, where provided, such as sign location and information (e.g., speed limit changes and icing conditions).

## Ultra-Reliability and Redundancy of Software

Developing reliability and redundancy remains a steep challenge to Level 4 AVs. According to UC Berkeley’s Steven Shladover,

The vehicle sensor, control, and actuation systems will need to be self-diagnosing, self-healing, and functionally redundant in

order to prevent their own failures of hardware or software from causing crashes. This will require extensive development and testing beyond the current state of the art for consumer systems and is likely to be very expensive.<sup>40</sup>

## Equipment Failure

AVs will need to be able to detect and act accordingly when sensors and other critical

equipment are failing for all the same reasons equipment on cars fails now, including poor design or construction, physical damage, or aging.

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*The average engineer thinks you just talk to the car and listen to the car to get information. That won't work for people who are deaf or hard of hearing.*

— Marc Riccobono, President,  
National Federation of the Blind

## Software Security

Passenger safety is reliant on software understanding the nature of threats posed by the environment. It also must be immune to harmful threats imposed by humans through the introduction of viruses or remote intervention over wireless networks. According to Raj Rajkumar of Carnegie Mellon, the technology does not yet exist.<sup>41</sup>



## Chapter 4 Potential Policy and Societal Barriers to the Independent Use of Autonomous Vehicles by People with Disabilities

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Policymakers,<sup>42</sup> Google,<sup>43</sup> and vehicle manufacturers<sup>44</sup> have frequently stated that they expect a Level 4 AV that people with disabilities will be able to use independently. While the ultimate vision of fully accessible AVs for people with disabilities who do not have a driver's license is often cited, research and development incentives in AVs follow the same principles as those for all market products: there must be the prospect of a market and significant revenues in order for companies to invest. According to research at Princeton University, a market appears to exist as shown by forecasts of an increase of vehicle miles traveled spurred by people who do not currently have driver's licenses:

When fleet penetration reaches 95% and when non-drivers are permitted to travel in robotic cars, VMT [vehicle miles traveled] increases may reach as high as 35% on portions of the transportation network.<sup>45</sup>

While the potential for profit is good, and private companies have taken the lead in AV research and development, there are still barriers to the realization of fully accessible AVs—barriers to the market in general and barriers specific to disability. The most significant policy and societal barriers to the realization of Level 4 AVs by people with disabilities are:

- A. Driver's Licensing, Regulations, and Model Legislation
- B. Cost and Income Disparity Barriers
- C. Attitudinal Barriers
- D. Liability
- E. Privacy
- F. Ethical Considerations
- G. Cybersecurity
- H. Infrastructure
- I. V2V Communications

### Driver's Licensing, Regulations, and Model Legislation

"For an autonomous vehicle without a steering wheel, I'm not sure you need any more training than you'd get for a dishwasher." Ryan Calo, University of Washington School of Law.<sup>46</sup>

We know that fully self-driving cars can bring individual mobility to people who do not have a driver's license, including people with disabilities, people who are aging, and youth. This begs the question, Is there any reason that an occupant of a Level 4 AV must be licensed? For all people with disabilities to benefit from the technology, the only answer is no, and it must be the same answer across all states, so that people with disabilities have the opportunity to use this technology no matter where they reside.

Notably, in the beginning, high levels of automated driving may rely on the road infrastructure as well as the vehicle. That is, both the vehicle and the road may need to be certified at Level 4. Accordingly, state and local agencies may need to determine if specific roads are ready for Level 4 vehicles.

Currently, states set the rules for issuing driver's licenses and operating vehicles, and NHTSA sets vehicle safety standards. NHTSA also works with states on a variety of licensing and driver behavioral issues. These laws and regulations anticipate a human driver, but for Level 4 autonomy, this premise is outdated and dictates that the laws need to be revisited. Some automakers and experts in the field are calling for national standards for safety, liability, privacy, security, and driver's licensing. When it comes to licensing drivers, however, stakeholders are split. NHTSA is reluctant to involve itself in "licensing, driving training, and conditions for operation related to specific types of vehicles."<sup>47</sup> Experts at the University of Texas at Austin, however, believe that the "U.S. DOT should develop a framework and set of national guidelines for AV licensing at the state level. With a more uniform set of standards in place, states can pool efforts developing safety, operational, and other requirements."<sup>48</sup>

Steven Shladover agrees and believes that vehicle automation calls for new rules: "There need to be national rules to govern all of this, but the legislative process is very slow."<sup>49</sup>

Given the existing patchwork of state laws in place for the testing of AVs (California, District

of Columbia, Nevada, Florida, and Michigan), the potential for vastly different licensing rules is real, and the Federal Government should consider regulations that preempt state laws to ensure that people with disabilities are not prevented from operating fully autonomous vehicles. In the *Houston*

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*The potential for vastly different licensing rules is real. The Federal Government should consider regulations that preempt state laws to ensure that people with disabilities are not prevented from operating fully autonomous vehicles.*

*Law Review*, attorney Julie Goodrich calls for the Federal Government to uniformly define who is an "operator" and create uniform preemption regulations using its power under the Commerce Clause of the Constitution. She also stated that Congress

has the option under the Supremacy Clause of the Constitution to create laws and regulations by preempting state statutes.<sup>50</sup>

### **Model Regulatory Framework**

NHTSA is involved in developing a national regulatory framework for AV operations that states can use and has provided funding to the AAMVA to establish an Autonomous Vehicle Best Practices Working Group. The Working Group has representatives from motor vehicle departments and law enforcement from 16 states and Canada, state legal and technology representatives, the AAMVA, and NHTSA. The purpose of the Working Group is to develop a best practices guide to assist states in developing regulations for operation of autonomous vehicles and for testing the drivers who operate them. It will consider input from stakeholders such as manufacturers, technology companies, and academic researchers.<sup>51</sup> The guide is due to NHTSA in the fall of 2016.<sup>52</sup> At the Working Group's first

meeting in February 2015, it established two guiding principles for the framework: (1) regulations should be broad enough to allow jurisdictions to adopt them within their state laws, policies, and practices, yet specific enough so there is consistency among jurisdictions; and (2) the framework should address the technology that will be available in the near future and identify a path for the development of regulations for technology that will be available into the distant future.<sup>53</sup>

Because the launch of AV technology by most vehicle manufacturers is expected to be incremental, the second principle is particularly relevant to the operation of AVs by people with disabilities. State regulations developed today must be flexible enough to ensure that when fully self-driving cars are available to the public, those regulations have anticipated that people who currently do not hold driver's licenses will be granted licenses.

Given the potential impact that the Working Group's recommendations will have on future regulations throughout the United States, NHTSA should ensure that people with disabilities and experts in accessible and assistive technology inform its work.

### ***Model Federal and State Legislation***

Appendix B to this report includes suggested model federal legislation relating to AVs, on which state laws should be predicated.

Bryant Walker Smith has drafted model state legislation that includes a brief but clear and unequivocal provision against disability discrimination in the use and operation of AVs by people with disabilities (Article 5.1.1):

Any natural person of legal driving age who solely by reason of physical disability

### **Model Disability Nondiscrimination Legislative Language**

"Any natural person of legal driving age who solely by reason of disability is ineligible for a [regular noncommercial] driving license shall be eligible for an automation-only license."

is ineligible for a [regular noncommercial] driving license shall be eligible for an automation-only license.

Walker Smith's language is a good start, but should be amended to omit the word "physical," as follows:

Any natural person of legal driving age who solely by reason of disability is ineligible for a [regular noncommercial] driving license shall be eligible for an automation-only license.

While this model legislation was developed for states, the Federal Government may also wish to use it, particularly the disability nondiscrimination provision, in any preemption legislation the Federal Government develops.

### **Cost and Income Disparity Barriers**

Affordability may be one barrier to the independent use of AVs by people with disabilities. While no one yet knows what AVs will cost, initial indications are contradictory.

For example, a report by KPMG and the Center for Automotive Research pointed out factors that would lead to a high-costing AV:

Creating a 360-degree view of the vehicle's environment requires a combination of sensors and may cost more than consumers

## Important Questions about AV Data

- Who owns and has control of the data?
- Can the data be used for marketing or sold?
- Will data be discoverable in legal proceedings?
- How long may data be retained?
- How will data be destroyed?

are willing to pay. Light Detection and Ranging (LIDAR)-based systems provide 360-degree imaging but are complex, expensive, and not yet ready for the market. The LIDAR system used in the Google car, for example, cost \$70,000. Value chain stakeholders will need to have a clear and compelling business case before investing in this technology.<sup>54</sup>

At the same time, most, if not all, producers of AVs will be private automakers that will wish to sell them, so they cannot viably remain unaffordable. It is expected that some will be high-end and some will be lower-end.

In cases where AVs circulate in a closed loop, or where a fleet of AVs will be shared and individually summoned by the user, the cost will be limited to the price points for rides taken, just as with car-share services today. These will likely be the most affordable way to use AVs.

### Attitudinal Barriers

As reflected in Chapter 5 and other polls and surveys, AVs receive mixed reviews regarding trust by the public. Many people do not trust

autonomous vehicles. However, most experts in the field believe public confidence will grow as automated features are phased in, as with any new technology. Jeffrey Miller, an associate professor of computer systems engineering at the University of Alaska-Anchorage, told Wired.com:

As more vehicular controls begin being automated, such as parallel parking and automatic braking, people will become more accepting of autonomous technologies. So by 2040, driverless vehicles will be widely accepted and possibly ... the dominant vehicles on the road.<sup>55</sup>

Many technology writers believe that AVs will be safer than cars with human drivers, after the rigorous safety testing that is expected. For example, a report by KPMG and the Center for Automotive Research stated,

Over 40 percent of ... fatal crashes involve alcohol, distraction, drug involvement and/or fatigue. Self-driven vehicles would not fall prey to human failings, suggesting the potential for at least a 40 percent fatal crash-rate reduction.... Such reductions do not reflect crashes due to speeding, aggressive driving, over-compensation, inexperience, slow reaction times, inattention and various other driver shortcomings. Driver error is believed to be the main reason behind over 90 percent of all crashes.<sup>56</sup>

And, according to the RAND Corporation,

Many factors contributed to reducing the rate of crashes, injuries, and fatalities—

including the gradual adoption of on-vehicle safety technologies. These systems were introduced in various model years: modern frontal air bags in 1984, antilock brakes in 1985, electronic stability control in 1995, head-protecting side air bags in 1998, and forward collision warnings in 2000. But it typically takes three decades for safety features that start out on luxury vehicles to reach the entire vehicle fleet, as older vehicles are replaced with newer models. If the adoption of forward collision warning systems continues on its current path (standard on one percent and optional on 11 percent of model year 2010 vehicles), it could take nearly 50 years to reach 95 percent of the fleet.

Based on the data from 1960 to 2011, the rate of fatalities has halved every two decades on U.S. roadways. It is likely that AVs could bend this fatality curve substantially. But the safety benefits will likely depend upon the level of automation.<sup>57</sup>

It will be important that any restrictions on use by people with disabilities be based on actual risks, rather than unsubstantiated fears associated with disabled people.

## Liability

“No one will insure a blind person to drive!”<sup>58</sup>

AVs will present many insurance and liability issues, especially as the technology is perfected and the role of human drivers diminishes. Even

with estimates that vehicle accidents will be decreased by 90 percent, there will be times when a crash is unavoidable. In a fully self-driving car, where there is no driver, who will be held liable? The insurance industry and vehicle manufacturers are thinking about how liability will be assigned in the future. Does liability shift to vehicle manufacturers, technology companies, or infrastructure providers (federal, state, and local governments)? Quoted in the *National Journal*, Brad Stertz of Audi said, “That’s going to be an issue. It’s tough to argue the passenger (who may well be the victim) should be held responsible if a car controlled by a computer runs itself off the road. But should automakers face long, expensive lawsuits when life-saving technology suffers a rare glitch?”

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*Even with estimates that vehicle accidents will be decreased by 90 percent, there will be times when a crash is unavoidable. In a fully self-driving car, where there is no driver, who will be held liable?*

If car owner liability decreases, the inverse may be true for car manufacturers, and as a result, they are considering whether to pass on the cost of risk to consumers.<sup>59</sup> It has been suggested that Congress should limit

their liability.<sup>60</sup>

While the issue of insurance coverage and liability remains unsettled, there are many years to solve it. In the meantime, it appears that the evolutionary nature of AVs fits within our current liability system.

The incremental approach to automation, having the computer do more and more and the driver less and less fits comfortably within the existing legal regime. The challenges are where that begins to break down in the

far reaches of automation so when a human is no longer engaged in any meaningful sense do they still have legal obligations even though they don't have technical requirements. When we see different service models, different vehicles that don't quite look like cars today, how will law treat them? It's concepts that are further from the present that pose the greatest legal challenges.<sup>61</sup>

Walker Smith's expectation for assigning liability in the future is not that different from what we see today.

That will be a very fact specific inquiry. Just as today, if two vehicles crash, we need to ask about the circumstances, about the behavior of the driver, about the environment in order to determine who is liable. In the future, if an automated vehicle crashes, we will likely ask the same questions. What was the human supposed to be doing if anything, did they properly maintain the car, did they use it in the right environment? Did the manufacturer properly instruct the human user about that? Did the manufacturer supervise the human to the extent that that was required? Did the vehicle make a mistake? If so, what caused the mistake? Was it incorrect data, was it incorrect programming, was it some other failure? All of those will need to be considered after the fact to determine in that specific issue who was liable.<sup>62</sup>

## Privacy

AVs should know where they are and software will produce substantial information about the

vehicle and its surroundings. Consumer groups have indicated concern about the tremendous amounts of data that will be generated about the car and its occupants. Depending on what data is generated, it can have high value for advertisers, retailers, insurance companies, and public safety agencies. Important questions raised by consumer groups include:

- Who owns and has control of the data?
- Can the data be used for marketing or sold?
- Will data be discoverable in legal proceedings?
- How long may data be retained?
- How will data be destroyed?

Reflecting on the experience of consumer adoption of the Internet, California's Consumer Watchdog wrote in 2012 to then California Assembly Speaker John Perez:

Without appropriate regulations, Google's vehicles will be able to gather unprecedented amounts of information about the use of those vehicles. How will it be used? Just as Google tracks us around the Information Superhighway, it will now be looking over our shoulders on every highway and byway.<sup>63</sup>

While data collection for marketing purposes may be concerning, data collection about health and disability raises even more concern. Such data should remain confidential and not be shared with companies and other entities. For example, AV companies should not be informed if an individual goes to kidney dialysis four times a week or an adult day health center six times a week.

Speaking at CES 2015, the annual high-tech trade show, Edith Ramirez, the chair of the U.S. Federal Trade Commission, warned of:

A future where smart interconnected devices enable technology firms to build a “deeply personal” and increasingly detailed and granular picture of consumers that will subject consumers to highly targeted advertising of products and services, as well as leaving them vulnerable to data attack.

Ms. Ramirez said that smart devices [including AV (connected cars)] could potentially collect data such as an individual’s health, religious and other lifestyle preferences, and asked, “*Will this information be used to paint a picture of you that you won’t see but that others will?*” Data should only be gathered for a specific purpose, said Ms. Ramirez ... “*I question the notion that we must put sensitive consumer data at risk on the off-chance a company might someday discover a valuable use for the information.*”<sup>64</sup> [Emphasis in original]

Data collection, management, ownership, and privacy issues are far from being settled and must be addressed by policymakers and the private sector.

## Ethical Considerations

Ethical considerations abound in the frontier technology of AVs. For example, discussions are already underway about how AVs should be programmed to decide who can be injured in an inevitable accident.<sup>65</sup> As the Associated Press wrote,

A large truck speeding in the opposite direction suddenly veers into your lane. Jerk

the wheel left and smash into a bicyclist? Swerve right toward a family on foot? Slam the brakes and brace for head-on impact?

Drivers make split-second decisions based on instinct and a limited view of the dangers around them. The cars of the future—those that can drive themselves thanks to an array of sensors and computing power—will have near-perfect perception and react based on preprogrammed logic.

While cars that do most or ... all of the driving may be much safer, accidents happen. It’s relatively easy to write computer code that directs the car how to respond to a sudden dilemma. The hard part is deciding what that response should be.<sup>66</sup>

Society’s prejudices about disability must not be projected into the realm of AVs. For example, if, for some reason, an AV “knows” there is a person with a disability or an older person in the vehicle, that knowledge must not become part of any program that may steer the vehicle’s decision-making process in unavoidable collisions. Driver’s licenses already include age information. If operating licenses for people with disabilities are permitted to include information about the person’s ability to take over manual operation and that is conveyed to other self-driving cars, software engineers could then make that information part of the calculus in a collision decision between the cars. Additionally, in a self-driving vehicle, an occupant’s disability status has no role in liability assignment.

## Cybersecurity

At a Senate hearing on vehicle technology, Sen. John Rockefeller asked witnesses, “And as our

cars become more connected—to the Internet, to wireless networks, with each other, and with our infrastructure—are they at risk of catastrophic cyber-attacks?”<sup>67</sup> The simple answer is yes.

As early as 2010, researchers from the University of California and University of Washington demonstrated that it was possible to introduce a virus into a car’s computerized systems that could cause it to crash by shutting down the engine or engaging the brakes.<sup>68</sup>

AV technology uses the same wireless technologies as cell phones, leaving them vulnerable to attacks from anywhere in the world. Cybersecurity experts have pointed out that carmakers have not adequately protected their systems, leaving them vulnerable to theft and control by hackers’ malicious attacks. Bruce Snell, an expert at McAfee, a leading digital security firm, pointed out how self-driving cars escalate the need for car manufacturers to resolve security issues.

If your laptop crashes you’ll have a bad day, but if your car crashes that could be life threatening. I don’t think people need to panic now. But the future is really scary.<sup>69</sup>

In response to Senator Rockefeller’s question, NHTSA Administrator David Strickland stated, “We have initiated cybersecurity research, with the goal of developing a preliminary baseline set of threats and how those threats could be addressed in the vehicle environment.”<sup>70</sup>

In response to growing concern that security issues might impact marketability, in July 2014 the Alliance of Automobile Manufacturers and the Association of Global Automakers announced plans to create an Information Sharing and

Analysis Center to address the cybersecurity threat, similar to those created by the energy, financial services, and other industry sectors.<sup>71</sup>

In February 2015, Sen. Edward Markey released a report detailing the responses from automakers to questions he posed to them about security of their digital systems. The report states, “These findings reveal that there is a clear lack of appropriate security measures to protect drivers against hackers who may be able to take control of a vehicle or against

those who may wish to collect and use personal driver information.”<sup>72</sup> Senator Markey’s report reinforces the need for policymakers

and the private sector to ensure that current and emerging technology have the capacity to prevent breaches by malicious agents.

## Infrastructure

Much of our attention is focused on the breakthrough in rapidly advancing technology taking place now and in the future in the drive to develop AVs. Just as interesting and breathtaking is the change that will occur in the public infrastructure. At a November 2013 House hearing on AV, U.S. Rep. Thomas Petri made it clear that Congress is aware that change is on the horizon and must act accordingly.

All of these concerns must be addressed before benefits from autonomous vehicles can be realized. Vehicles and infrastructure that they utilize are becoming increasingly integrated with computer technology, which has the potential to revolutionize highway safety and mobility in our country. In order to see these benefits come to fruition,

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*If your laptop crashes you’ll have a bad day, but if your car crashes that could be life threatening.*

– Bruce Snell, McAfee

Federal and State officials should begin planning for the benefits and the challenges that autonomous vehicles will bring to the future of our Nation's surface transportation system.<sup>73</sup>

The extent to which our infrastructure needs to be upgraded, what it will cost, or how it will be funded is not yet known or agreed upon. On the one hand, Google and carmakers such as Nissan and GM have maintained that their AVs will not require substantial change to the public infrastructure. Mike Robinson, GM Vice President of Sustainability and Global Regulatory Affairs, testified at the November 2014 House hearing:

It should not be surprising that GM is investing in technologies that ultimately will provide even greater levels of driver assistance and vehicle management, and importantly, we are working on systems that do not require dramatic upgrades or modifications to the national highway infrastructure network.

To the greatest degree possible, our goal is to keep the systems we are talking about contained within the vehicles and between the vehicles. However, we do have one low-tech need: clearly marked lanes and shoulders. This will enhance the capabilities of these technologies that we are already using to sense the road, such as radar, ultrasonic sensors and cameras, along with, of course, GPS location capabilities.<sup>74</sup>

On the other hand, Terry Bennett, the senior industry program manager and lead strategist for civil infrastructure at Autodesk, believes that vehicles are only as smart as the infrastructure that surrounds them. Bennett contends that

the investments in smarter infrastructure will provide benefits that go beyond transportation to other kinds of infrastructures such as water and utilities.<sup>75</sup>

I think [autonomous cars] more than anything create a lot of space for people to think differently.... But with Detroit and other cities looking at dedicated roads for vehicle-to-vehicle or vehicle-to-infrastructure communication, you're starting to see the point that having infrastructure that's intelligent, has sensors and can communicate, is a much better long term approach than trying to automate a single car.<sup>76</sup>

In recognition of the challenges and opportunities that AVs and connected vehicles pose for the national infrastructure, the American Association of State Highway and Transportation Officials released "National Connected Vehicle Field Infrastructure Footprint Analysis." This report helps state and local agencies understand and know to prepare for a future of vehicles requiring V2V and V2I communications, and what investments may be needed.<sup>77</sup>

## V2V Communications

Many stakeholders, such as automakers BMW and Nissan, along with the DOT, believe that V2V, V2I, and vehicle-to-everything (V2X) technologies (e.g., cell phones, pedestrians, and cyclists) will help support the development of AVs because they will afford AV systems with more robust information. These communications will require a secure, fast, and extremely reliable network. The Federal Government had the foresight to support the development of dedicated short-range

communications applications that allow V2V and V2I communications, and the FCC has reserved 5.9 gigahertz bandwidth for this use.

Nevertheless, with the phenomenal expansion of devices and technologies that use broadband, the FCC is considering allowing nonautomotive wireless technologies the use of a portion of this reserved block, which has carmakers and others concerned. Joachim Taiber, Director of the International Center for Automotive Research at Clemson University, stated bluntly, "A dropped call on a cell phone caused by interference is no big deal, but the loss of even a little data on a car's collision-avoidance system could be fatal."<sup>78</sup>

At the November 2013 House hearing on AV, Kirk Steudle from the Michigan Department of Transportation told representatives that the FCC's contemplation of giving away some of the bandwidth must be considered carefully:

Connected vehicle technology must have a secure and fast communications network to work, faster than is currently available with traditional cellular communications. The FCC has reserved 5.9 gigahertz bandwidth for this use. They are now considering sharing this use with other wireless communications providers, and we think that that needs to be done very cautiously.<sup>79</sup>

## **NCD Recommendations for Preventing or Eliminating Technological, Policy, and Societal Barriers to the Independent Use of Autonomous Vehicles by People with Disabilities**

1. Congress should appropriate funds to DOT so that NHTSA has the resources to ensure that all user interface systems on autonomous vehicles are fully accessible to people with diverse disabilities.
2. All federal requests for proposals that provide funding for the research or development of AVs or components should include a requirement that respondents demonstrate that any products resulting from the research or development incorporate accessibility, and that all resulting products will be fully accessible for people with diverse disabilities. All technology products should be required to comply with Section 508 of the Rehabilitation Act.
3. Congress should increase funding to DOT's Intelligent Transportation Systems' Joint Program Office to ensure that NHTSA and other DOT modes can conduct research on AVs and develop tools to establish safety and accessibility standards for AVs.
4. Policymakers should support research into how AVs could affect transportation and land-use patterns, and how to best alter U.S. transportation systems to maximize benefits while minimizing negative consequences of the transition to a largely autonomous fleet of motor vehicles. This should include the relationship of AVs to public transit.
5. Carmakers and DOT (as well as the 50 state DOT agencies) should work together to create a national "smart highway" initiative and draft plans for AVs, rather than allowing the development of a confusing and conflicting patchwork of plans across the United States.
6. DOT should develop a framework and set of national guidelines for AV licensing at the state level. The development of the guidelines should include input from a cross-section of people with disabilities, and the guidelines should not impose limitations on people with disabilities to the extent possible. Any restrictions must be based on actual risks rather than unsubstantiated fears about people with disabilities.
7. Congress should pass legislation that establishes firm limitations regarding privacy of AV-related data.
8. Congress should pass legislation that, as software is developed to make decisions about harm in unavoidable collisions, collected data should not include disability-specific information about the passengers in AVs.
9. Legislation should preclude discrimination on the basis of disability by states or any other governmental authority in licensing for the use of AVs. The remedy should be the withholding of federal highway funds to states that refuse to bring their licensing rules into

compliance with this federal requirement. Such a provision would parallel the approach historically taken by the Federal Government with respect to the legal drinking age.

10. Congress should allocate, and the Executive Branch should administer, low-interest loans, subsidy programs, financing, and tax credits (among other examples) to help people with disabilities and low-income individuals and families to afford AVs.
11. Congress should pass legislation requiring full accessibility for all types of common and public use AVs. Legislation should define a process that includes meetings with manufacturers, disability groups, and NHTSA. Relatedly, a disability advisory committee for automation should be created. The U.S. Access Board should be delegated this responsibility, as well as that of developing standards. Existing rules, including Section 504 of the Rehabilitation Act and the Americans with Disabilities Act, should be interpreted to require accessible AVs, including additional regulation by the U.S. Department of Justice, if needed.
12. Congress should pass legislation requiring that, as a matter of civil rights, all new technology incorporate the needs of people with disabilities at the earliest possible point. Congress should create a transportation institute to guarantee that new transportation technology is accessible to people with disabilities. A permanent task force or other oversight body should bring together federal and state governments, private sector manufacturers, and the legal and insurance industries to create a complete package that will enable universal use of vehicles and other forms of transportation as they emerge.
13. People with disabilities and accessibility experts must be included in all future Congressional hearings concerning AVs.

## Appendix A Summary of Enacted State Laws on Autonomous Vehicles

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State	Bill No.	Purpose	Date Enacted	Bill Text
California	SB 1298	Defines autonomous vehicles and authorizes the operation of autonomous vehicles for testing if specified requirements are met, including that the driver be seated in the driver's seat, monitoring the safe operation of the autonomous vehicle, and capable of taking over immediate manual control of the autonomous vehicle in the event of an autonomous technology failure or other emergency. The bill also required the California Department of Motor Vehicles (CA DMV) to issue regulations by January 1, 2015, that establish the requirements that manufacturers must meet to certify that their autonomous vehicle has been successfully tested, meets certain safety requirements, and is ready for the public to operate on public roads. The CA DMV missed the January 1, 2015, deadline.	9/25/13	<a href="http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_1251-1300/sb_1298_bill_20120925_chaptered.pdf">http://www.leginfo.ca.gov/pub/11-12/bill/sen/sb_1251-1300/sb_1298_bill_20120925_chaptered.pdf</a>
District of Columbia	B 19-0931	To authorize autonomous vehicles to operate on District roadways, to require the Department of Motor Vehicles to create an autonomous vehicle designation, and to establish safe operating protocols for autonomous vehicles.	1/23/13	<a href="http://dcclims1.dccouncil.us/images/00001/20130110191554.pdf">http://dcclims1.dccouncil.us/images/00001/20130110191554.pdf</a>

State	Bill No.	Purpose	Date Enacted	Bill Text
Florida	CS/HB 1207	Provides for operation of autonomous motor vehicles on public roads; directs DHSMV to prepare report on safe operation of such vehicles; provides for content of report; requires submission of report to Legislature.	4/16/12	<a href="http://www.myfloridahouse.gov/Sections/Documents/loadoc.aspx?FileName=_h1207er.docx&amp;DocumentType=Bill&amp;BillNumber=1207&amp;Session=2012">http://www.myfloridahouse.gov/Sections/Documents/loadoc.aspx?FileName=_h1207er.docx&amp;DocumentType=Bill&amp;BillNumber=1207&amp;Session=2012</a>
Michigan	SB 0169	To define autonomous vehicles and allow testing by certain parties under certain conditions and directs the Michigan Department of Transportation to report by February 1, 2016, whether any additional legislative or regulatory action that may be necessary for the continued safe testing of automated motor vehicles and automated technology installed in motor vehicles.	12/26/12	<a href="http://www.legislature.mi.gov/documents/2013-2014/publicact/htm/2013-PA-0231.htm">http://www.legislature.mi.gov/documents/2013-2014/publicact/htm/2013-PA-0231.htm</a>
Nevada	AB 511	Requires the Nevada Department of Motor Vehicles (NV DMV) to adopt regulations allowing autonomous vehicles in Nevada and defines "autonomous vehicle." It also requires the NV DMV to create regulations to establish a driver's license endorsement for the operation of an AV in Nevada.	6/17/11	<a href="http://www.leg.state.nv.us/Session/77th2013/Bills/AB/AB511.pdf">http://www.leg.state.nv.us/Session/77th2013/Bills/AB/AB511.pdf</a>
Nevada	SB 313	Amends the law to state that there must be a human present in the driver's seat during testing, relieves original manufacturers of vehicles of liability for injury that results from a conversion to an autonomous vehicle by a third party, and requires \$5,000,000 liability insurance before testing an AV in the state.	6/2/13	<a href="http://leg.state.nv.us/Session/77th2013/Bills/SB/SB313_EN.pdf">http://leg.state.nv.us/Session/77th2013/Bills/SB/SB313_EN.pdf</a>

## Appendix B Model Legislation

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### Model Legislative Language – Recommendation No. 6

Language for the development of national guidelines ensuring nondiscrimination on the basis of disability in autonomous vehicle licensing.

Act to Ensure Nondiscrimination on the Basis of Disability for Autonomous Vehicle Operating Licenses and Establishing an Autonomous Vehicle Licensing Disability Advisory Committee

#### Findings

- (1) Because there exists a patchwork of state laws for the testing of autonomous vehicles, and the potential for vastly different state driver's licensing rules is real, there is a need for federal guidance to ensure that people with disabilities across the United States are, in a consistent way, not prevented from operating fully autonomous vehicles, particularly people with disabilities who are currently unable to obtain a driver's license;
- (2) in enacting the Americans with Disabilities Act (ADA), Congress sought to "provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities;"
- (3) there is a need to ensure that Level 4 autonomous vehicles, as defined by the National Highway Traffic Safety Administration (NHTSA), are accessible to and operable by people with disabilities, particularly people with disabilities who currently are unable to obtain a driver's license.

#### Purposes

The purposes of this act are

- (1) to ensure that state or federal autonomous vehicle licensing regulations do not discriminate on the basis of disability;
- (2) to develop guidance that ensures that state or federal regulations do not impose limitations on the operation of autonomous vehicles by people with disabilities to the extent possible; and
- (3) to ensure that the development of federal guidance for autonomous vehicle licensing includes input from a cross-section of people with disabilities.

## Definitions

- (1) “disability” means a physical or mental impairment that substantially limits one or more major life activities of an individual, a record of such impairment, or being regarded as having such an impairment. This definition must be broadly interpreted, consistent with the ADA Amendments Act of 2008.
- (2) “autonomous vehicle” means a Level 4 autonomous vehicle capable of full self-driving automation as defined by NHTSA. The autonomous vehicle can drive itself without a human driver. The driver will provide trip or navigation input but is not expected to be available to take control of the vehicle at any time during the trip.
  - (a) IN GENERAL. To ensure that no state deny a person a license to operate an autonomous vehicle solely on the basis of the person’s disability, the Secretary of Transportation will disseminate guidance to the states to ensure that people with disabilities are not prevented from operating fully autonomous vehicles, particularly people with disabilities who are currently unable to obtain a driver’s license. The Secretary shall consider the recommendations of the autonomous vehicle licensing disability advisory committee established in subsection (b) when developing the guidance.
  - (b) AUTONOMOUS VEHICLE LICENSING DISABILITY ADVISORY COMMITTEE.
    - (1) ESTABLISHMENT. Not later than 60 days after passage of this Act, the Secretary of Transportation shall establish an advisory committee to be known as the Autonomous Vehicle Licensing Disability Advisory Committee (“Advisory Committee”).
    - (2) MEMBERSHIP. The Advisory Committee shall be composed of the following members:
      - (A) The Secretary of Transportation (or the Secretary’s designee).
      - (B) The Administrator of NHTSA (or the Administrator’s designee).
      - (C) The Director of the Office for Civil Rights, Department of Transportation (or the Director’s designee).
      - (D) The Chairperson of the National Council on Disability (or the Chairperson’s designee)
      - (E) The following members, to be appointed by the Secretary:
        - (i) Representatives of State departments of motor vehicles, and state public safety agencies;
        - (ii) Representatives of national organizations representing people with disabilities. Individual representatives shall include but are not limited to individuals who are blind and who have visual impairments; individuals who are deaf and who have hearing loss; individuals with intellectual, cognitive, or development disabilities; and individuals who have mobility disabilities;
        - (iii) Representatives of national organizations representing people who are elderly;
        - (iv) Experts in accessible and assistive technology; and
        - (v) Qualified representatives of such other stakeholders as the Secretary considers appropriate.

- (3) RECOMMENDATIONS. The Advisory Committee will develop recommended guidelines for autonomous vehicle licensing that ensure that federal or state regulations do not discriminate or set limitations on the operation of autonomous vehicles by people with disabilities to the extent possible and that any such restrictions be based on actual risks, rather than unsubstantiated fears associated with people with disabilities.
- (4) REPORT. The Advisory Committee will submit its report to the Secretary not later than six months after the date of the establishment of the Advisory Committee.
- (5) The Secretary will disseminate the guidelines to the states within six months after the date of receipt of the Advisory Committee's report.

### **Model Legislative Language – Recommendation No. 9**

Congressional legislation should preclude discrimination on the basis of disability by states or any other governmental authority in licensing for the use of AVs. The remedy should be the withholding of federal highway funds to states that refuse to bring their licensing rules into compliance with this federal requirement. Such a provision would parallel the approach historically taken by the Federal Government with respect to the legal drinking age.

### **Uniform Disability Nondiscrimination Autonomous Vehicle Licensing Act**

- (a) Withholding of Funds for Noncompliance.
  - (1) In general.
    - (A) The Secretary shall withhold 10 percent of the amount of Federal-aid highway funds to be apportioned to any State that discriminates on the basis of disability in licensing individuals to use or operate Level 4 autonomous vehicles as defined by the National Highway Traffic Safety Administration (NHTSA).
    - (2) A state will be found in compliance if enacted licensing regulations have affirmative statements of nondiscrimination on the basis of disability that meet or exceed standards from the Department of Transportation guidance to the states on nondiscrimination on the basis of disability in licensing people with disabilities to use or operate autonomous vehicles dated \_\_\_\_\_.
    - (b) Effect of Withholding of Funds. No funds withheld under this section from apportionment to any State after \_\_\_\_\_, shall be available for apportionment to that State.
    - (c) Discrimination on the basis of disability includes promulgating, implementing, or enforcing licensing regulations that have the effect of denying people with disabilities who have reached the legal driving age a license to use or operate a Level 4 autonomous vehicle solely on the basis of their disability.

### **Model Legislative Language – Recommendations No. 11 and No. 12**

Congress should adopt legislation requiring full accessibility for all types of autonomous vehicles, based on minimum standards from the U.S. Access Board, which must include convening a meeting with manufacturers, disability groups, and NHTSA.

Congress should enact legislation requiring that all new technology incorporate the needs of people with disabilities at the earliest possible point, as a matter of civil rights.

## Ensuring Accessibility in Autonomous Vehicles

### Findings

- (1) while emerging technologies such as websites, consumer devices, and software applications have transformed the way Americans work, communicate, shop, and learn, many of these technologies are inaccessible to people with vision, hearing, and/or other disabilities because accessibility was not considered during research and development;
- (2) in enacting the Americans with Disabilities Act (ADA), Congress sought to “provide a clear and comprehensive national mandate for the elimination of discrimination against individuals with disabilities;”
- (3) there is a need to ensure that Level 4 autonomous vehicles, as defined by the National Highway Traffic Safety Administration (NHTSA), are accessible to and operable by people with disabilities, particularly people with disabilities who currently are unable to obtain a driver’s license.

### Definitions

- (1) “disability” means a physical or mental impairment that substantially limits one or more major life activities of an individual, a record of such impairment, or being regarded as having such an impairment. This definition must be broadly interpreted, consistent with the ADA Amendments Act of 2008.
- (2) “autonomous vehicle” means a Level 4 autonomous vehicle capable of full self-driving automation as defined by NHTSA. The autonomous vehicle can drive itself without a human driver. The driver will provide trip or navigation input, but is not expected to be available to take control of the vehicle at any time during the trip.
- (3) “assistive technology” is any item, piece of equipment, or system, whether acquired commercially, modified, or customized, that is commonly used to increase, maintain, or improve functional capabilities of individuals with disabilities.
- (4) “accessible” means a product that complies with standards developed by the U.S. Access Board.
  - (a) IN GENERAL. To ensure that Level 4 autonomous vehicles, as defined by the National Highway Traffic Safety Administration (NHTSA), are accessible to and operable by people with disabilities, particularly people with disabilities who currently are unable to obtain a driver’s license.

## U.S. ACCESS BOARD’S AUTONOMOUS VEHICLE ACCESSIBILITY ADVISORY COMMITTEE.

- (1) ESTABLISHMENT. Not later than 90 days after passage of this Act, the U.S. Access Board shall establish an advisory committee to be known as the Autonomous Vehicle Accessibility Advisory Committee (“Advisory Committee”).

- (2) MEMBERSHIP. The Advisory Committee shall be composed of the following members:
- (A) The Secretary of Transportation (or the Secretary's designee).
  - (B) The Administrator of NHTSA (or the Administrator's designee).
  - (C) A representative of the Department of Transportation, Office of the Assistant Secretary for Research and Technology.
  - (D) The Chairperson of the National Council on Disability (or the Chairperson's designee)
  - (E) The following members:
    - (i) Representatives of national organizations representing individuals with disabilities. Individual representatives shall include but are not limited to individuals who are blind and who have visual impairments; individuals who are deaf and who have hearing loss; individuals with intellectual, cognitive, or development disabilities; and individuals who have mobility disabilities;
    - (ii) Representatives of national organizations representing people who are elderly;
    - (iii) Experts in accessibility and assistive technology;
    - (iv) Representatives of automotive manufactures;
    - (v) Representatives of companies developing autonomous vehicle technologies, including software, vehicle parts or components;
    - (vi) Qualified representatives of such other stakeholders as the Secretary considers appropriate.
  - (F) CONSULTATION WITH NONMEMBERS. The Advisory Committee shall consult with groups that are not represented on the Advisory Committee, especially to consider new and developing technologies that may help to ensure that autonomous vehicles will be accessible to and operable by people with disabilities who currently cannot obtain a driver's license. Those groups may be:
    - (i) entities engaged in federally funded research; and
    - (ii) academic institutions engaged in relevant work and research.
- (3) MEETINGS.
- (A) INITIAL MEETING. The initial meeting of the Advisory Committee shall take place not later than 150 days after the date of enactment of the Ensuring Accessibility of Autonomous Vehicles Act.
  - (B) OTHER MEETINGS. After the initial meeting, the Advisory Committee shall meet at least semi-annually.
- (4) CONSULTATION WITH NONMEMBERS. The Advisory Committee shall regularly meet with groups that are not represented on the Advisory Committee to consider new and emerging technology that may be beneficial in ensuring the accessibility of autonomous vehicles.
- (5) RECOMMENDATIONS. The Advisory Committee will develop and submit annual reports under paragraph (7), including recommendations for the development of standards that ensure that autonomous vehicles are accessible to people with disabilities. The recommendations shall include protocol for ensuring that standards can be amended to incorporate emerging and future technologies.

(6) REPORT. The Advisory Committee will submit a report to the Secretary and the U.S. Access Board not later than 18 months after the date of the establishment of the Advisory Committee, and every year thereafter until Congress sunsets the Advisory Committee.

(c) INTEGRATING ACCESSIBILITY REQUIREMENTS INTO THE DESIGN PROCESS.

(1) The Department of Transportation, Office of the Assistant Secretary for Research and Technology (OST-R) shall be responsible for ensuring that federally funded autonomous vehicle research and development incorporate the needs of people with disabilities at the earliest possible point.

## Appendix C List of Interviews

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Harry Brown, national disability advocate, Port Huron, MI, July 18, 2014.

Ann Cupolo-Freeman, Member, Board of Directors, Disability Rights Education & Defense Fund, July 28, 2014.

Lauren Grudzinski, Work Incentive Benefits Specialist, Independence First, Milwaukee, WI, July 15, 2014.

Sarah Holland, U.S. Public Policy for Strategy & Programs on Youth and Technology, Google, September 29, 2014.

David New, Chair, Disability Access Committee of Miami Beach and President, Miami Beach Council of the Blind, July 8, 2014.

Mark Riccobono, M.S.ed, President, National Federation of the Blind, October 7, 2014.

Karen Rose, Marriage and Family Therapist and person who is blind, July 9, 2014.

Daniel C. Smith, Senior Associate Administrator for Vehicle Safety; Nathaniel Beuse, Associate Administrator for Vehicle Safety Research; R. Ryan Posten, Associate Administrator for Rulemaking; Steve Wood, Office of Chief Counsel; and Regina Morgan, Office of Civil Rights; National Highway Traffic Safety Administration (NHTSA); December 3, 2014.

Bernard Soriano, Deputy Director, California Department of Motor Vehicles, September 29, 2014 and May 27, 2015.



## Endnotes

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- 2 National Highway Traffic Safety Administration (NHTSA), "Preliminary Statement of Policy Concerning Automated Vehicles," May 30, 2013, accessed March 3, 2015, [www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated\\_Vehicles\\_Policy.pdf](http://www.nhtsa.gov/staticfiles/rulemaking/pdf/Automated_Vehicles_Policy.pdf).
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- 11 Paul Stenquist, "In Self-Driving Cars, a Potential Lifeline for the Disabled," *New York Times*, November 7, 2014, [www.nytimes.com/2014/11/09/automobiles/in-self-driving-cars-a-potential-lifeline-for-the-disabled.html?\\_r=0](http://www.nytimes.com/2014/11/09/automobiles/in-self-driving-cars-a-potential-lifeline-for-the-disabled.html?_r=0).
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