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# Automated Vehicle Safety Expert Panel: Engaging Drivers and Law Enforcement

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AUGUST 2019

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The report was overseen by GHSA Executive Director Jonathan Adkins and Director of Government Relations Russ Martin. Senior Director of Communications and Programs Kara Macek and Communications Manager Madison Forker edited the report. The views and recommendations in this publication do not necessarily reflect those of GHSA, State Farm® or the individuals or organizations represented on the expert Panel. The report was designed by Brad Amburn.

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## Introduction

Automated vehicles—vehicles with technology that can perform some or all driving tasks, called AVs for short—already are appearing on our roads. Their presence will expand steadily in the coming years. While AVs will change our lives in many ways, they raise important highway safety issues. Two groups that AVs will impact directly are law enforcement agencies, including the broader criminal justice system, and state highway safety offices (SHSOs).

On May 8, 2019, the Governors Highway Safety Association (GHSA) and State Farm® convened a panel of experts representing the federal government, the automotive and technology industries, criminal justice organizations, national safety groups, insurance companies, and SHSOs. The panel meeting's participants are provided in the Appendix.



The panel's charge was to discuss the most important issues that should be addressed by law enforcement and the SHSOs and to provide recommendations on steps that they should take, in cooperation with other stakeholders involved with AV testing and deployment, to address these issues.

This report summarizes the panel's deliberations, conclusions, and recommendations, together with some suggestions on how the recommendations could be implemented. It focuses on SHSOs and law enforcement. It addresses the federal government, the AV industry, insurance companies, safety advocates, and state and local policymakers in areas where their actions may affect SHSOs and law enforcement. The report's views and recommendations come from the panel's collective discussion and do not necessarily represent the views of any individual panel member or any panel member's organization.







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## Brief Background on Automated Vehicles

**AV levels.** In this report, an automated vehicle (AV) is a vehicle that can control at least one driving function. AVs currently are classified at Levels 1 through 5 by the Society of Automotive Engineers (SAE) and the National Highway Traffic Safety Administration (NHTSA, 2018a).

Most vehicles on the road today are Level 0, many are Level 1 and some are Level 2. Level 1 and 2 vehicles incorporate a wide variety of driver assistance and safety features, sometimes referred to as Advanced Driver Assistance Systems (ADASs). Examples include adaptive cruise control and automatic parallel parking. For a description of 40 such features, see MyCarDoesWhat.org (2019).

## AV TERMINOLOGY AND LEVELS

				Automated Driving Systems (ADS)		
	Level 0 No Automation	Level 1 Driver assistance	Level 2 Partial automation	Level 3 Limited self-driving (conditional automation)	Level 4 Full self-driving under certain conditions (high automation)	Level 5 Full self-driving under all conditions (full automation)
Vehicle	No automation.	Can assist driver in some situations.	Can take control of speed and lane position in certain conditions.	Can be in full control in certain conditions and will inform the driver to take control.	Can be in full control for the entire trip in these conditions and can operate without a driver.	Can operate without a human driver and need not have human occupants.
Driver	 In complete control at all times.	 Must monitor, engage controls, and be ready to take over control quickly at any moment.	 Must monitor and be ready to take over control quickly at any moment.	 Must be ready to take control quickly when informed.	 Not needed	 Not needed

Design by Winking Fish

AVs at Levels 3-5 can be in full control at least under certain conditions. They are called Highly Automated Vehicles (HAVs). The term Automated Driving System (ADS) vehicles also is used.

The goal of current HAV testing is to deploy Level 4 vehicles. Level 5 is still in the future (Boudette, 2019).

**Human vs. HAV operations.** HAVs under automated control operate differently than vehicles driven by human drivers.

HAVs currently being tested or deployed on public roads are being programmed to	Human drivers
✓ Obey all traffic laws	✗ Violate traffic laws daily
✓ Strictly obey speed limits	✗ Often travel above the speed limit, especially on interstates and other controlled-access roads
✓ Come to a complete stop at a stop sign	✗ Sometimes "roll through" stop signs

If drivers of conventional vehicles do not understand that another vehicle in traffic will obey speed limits and stop signs, either because they cannot identify that it's an HAV or that they do not know that an HAV will obey these and other traffic laws, crashes will occur. Extensive HAV testing in California has produced more than 160 crashes, almost all resulting from a conventional vehicle striking an HAV. Many were rear-end crashes at a controlled intersection, where a following driver did not understand that the HAV would come to a complete stop (California DMV, 2019).

**AV and HAV deployment status and projections.** HAV deployment on public roads begins with testing. Testing is widespread, by many developers: over 60 have testing permits in California (ibid.). HAV testing by at least nine developers is taking place in at least twelve states. Some testing activities are described in the Current State Automated Vehicle Activities section (see pg. 6); see also Verger (2018). Each developer conducts testing in a limited geographical area, monitored by a test driver in each vehicle. Truly driverless testing with no backup driver on board is only beginning, with Waymo now authorized for driverless tests in California (ibid.).

A few commercial HAV systems are now operating, including in northeast Denver, a retirement community in Florida, downtown Detroit, the University of Michigan campus, Las Vegas, and Columbus Ohio (Automated shuttles, 2019). The vehicles are Level 4, operating in a limited geographical area and serving a limited group of riders. Commercial Level 4 operations may spread fairly rapidly to transport people through ride-hailing services such as Lyft, Uber and others, to provide local delivery of groceries, food, and other goods, and to provide long-haul goods movement through truck convoys. Commercial operations allow a single operator to work with a single HAV provider. Commercial operations also are conducted in controlled environments in which HAV performance can continue to be tested and the knowledge base for HAV software systems can be improved. Hicks and Fitzsimmons (2019) summarize the activities of major HAV developers as of June 2019.

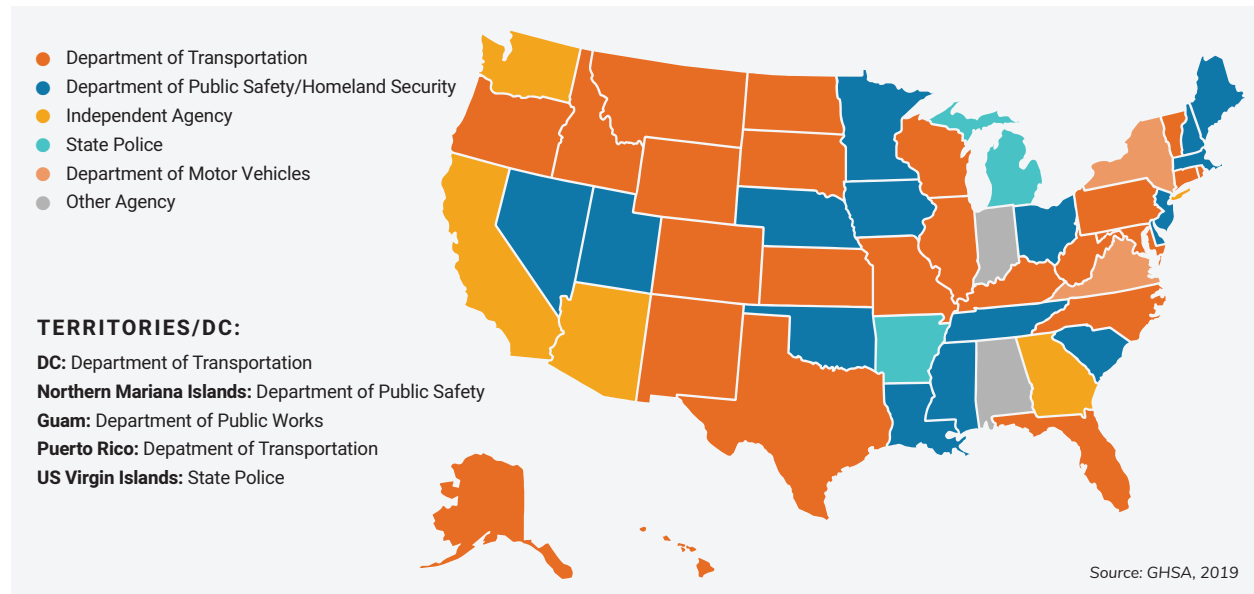
Manufacturers will continue to introduce increasingly sophisticated ADAS systems into their new vehicles available for direct purchase and ownership by the general public, bringing many of them up to Level 2. But discussion at the panel concluded that individual ownership and use of HAVs probably is unlikely for at least several years.

**Anticipating the mixed fleet.** There will be a mixed fleet of driver-operated vehicles and HAVs for a long time, perhaps forever, for several reasons. Motor vehicles are expensive, and HAVs will be more expensive than conventional vehicles. Vehicles last many years: the average age of cars on the road in 2018 was 12 years (Ratchetandwrench, 2018). Some drivers may prefer to retain conventional vehicles for a variety of reasons. Finally, HAVs sometimes may be driven manually: 80% of drivers in two surveys said that an HAV should allow both manual and automated operation (GHSA, 2018). Some HAV developers plan to allow their HAVs to be manually controlled, at least initially (Wayland, 2019).

**“There will be a mixed fleet of driver-operated vehicles and HAVs for a long time.”**

In the coming decades the roads will be shared by vehicles with a wide range of automation: older vehicles at Level 0, lacking even cruise control; Level 1 and 2 vehicles with a wide variety of ADAS systems, some of which may tempt drivers into believing they can relinquish control; and Level 3 through 5 HAVs. SHSOs, law enforcement, and the highway safety community overall should expect to deal with the issues presented by the full range of these vehicles and their interactions with each other and with other road users.

# The Role of State Highway Safety Offices



## STATE BEHAVIORAL HIGHWAY SAFETY PROGRAMS AND PARTNERSHIPS

Each state has a highway safety office, led by a Governor’s Highway Safety Representative, responsible for administering the federal behavioral highway safety program (GHSA, 2004). About half the SHSOs are located in a state’s Department of Transportation. Others are located in the state Department of Public Safety, some other state department or are independent agencies.

SHSOs have access to several federal grant programs administered by NHTSA. The Section 402 State and Community Highway Safety Grant Program funds can be used for any behavioral highway safety purpose, subject to approval by NHTSA through each SHSO’s annual Highway Safety Plan. Other funding, through the Section 405 National Priority Safety Program and other grant programs, must be used for specified highway safety areas, such as impaired driving, occupant protection, distracted driving, motorcyclist safety and traffic records (GHSA, 2019). In Fiscal Year 2018, Congress made \$278.3 million available to states through Sec. 402 and \$361.9 million through other Sections for a total of \$640.2 million (NHTSA, 2018b).

To implement their highway safety programs, states award these funds in grants to state and local agencies, law enforcement, judicial systems, non-profits, schools, universities and other organizations involved in behavioral highway safety. Typical activities include support for public and community education and engagement, law enforcement, training, criminal justice programs, and traffic records data programs.

SHSO operations are constrained in several ways. Federal grant-funded programs must

comply with federal and state grant regulations. A significant proportion of funding is restricted to specific highway safety program areas and sometimes to specific program types within an area. Each project must be justified in the state’s annual Highway Safety Plan by data-driven problem identification that documents what the project will address and justifies that the project is likely to be successful. Each project must be tied to a performance measure that can be used to determine if it did in fact reduce crashes, injuries and fatalities or otherwise improve some important highway safety measure. For details, see the Code of Federal Regulations (OFR, 2019)

The use of NHTSA grant funds for programs related to AVs is not explicitly authorized in federal law, though arguably these activities could be included under provisions to “reduce accidents resulting from unsafe driving behavior” (USC Title 23 Section 402 (a)(2)(vi)) and to “improve law enforcement services in motor vehicle accident prevention, traffic supervision, and post-accident procedure” (USC Title 23 Section 402 (a)(2)(vii)). NHTSA could clarify how SHSOs might use NHTSA funds for activities described in this report by issuing guidance, similar to its guidance clarifying the use of funding to sponsor Driver Alcohol Detection System for Safety (DADSS) research projects (NHTSA, 2019). Congress also could directly authorize the use of NHTSA grant funds for AV safety programs.

SHSOs also can operate through partnerships, with or without federal funding. SHSOs implement many highway safety programs with funding support from non-government partners such as businesses, associations and other organizations. These non-governmental partnerships broaden the scope of activities SHSOs can engage in, while SHSOs can offer credibility, behavioral highway safety expertise and other benefits to collaborative partnership activities. SHSOs also participate regularly in state task forces and steering committees on specific highway safety issues.

## **STATE HIGHWAY SAFETY OFFICES AND AUTOMATED VEHICLES**

SHSOs form a critical link between the companies who develop and will produce and market AVs and the businesses and private citizens who will use them. The SHSOs’ sole mission is highway safety. They work with, provide information to, mediate between, influence and are trusted by drivers and other road users, law enforcement and criminal justice organizations and staff, first responders, citizen activists, departments of transportation and public safety, and the federal government. The SHSOs can have a unique role in ensuring that AVs and HAVs are used safely and effectively.

**“The SHSOs can have a unique role in ensuring that AVs and HAVs are used safely and effectively.”**

Current SHSO engagement in AV-related policies and programs varies considerably across the states. Some SHSOs are leaders or active participants in state HAV activities, task forces, or working groups. For example, the California Office of Traffic Safety has served on California’s Autonomous Vehicle Steering Committee (Soriano, 2018), and the Director of the Washington Traffic Safety Commission serves as Chair of Washington’s Autonomous Vehicle Work Group (WSTC, 2019). Others have not yet taken on AVs or HAVs as a priority (GHSA, 2018). The panel noted some challenges to SHSO involvement in AV activities:

- » SHSOs may not be ready to focus on HAV safety until additional testing on public roads has taken place;

- » SHSOs may not be able to allocate funding to AVs or HAVs without demonstrating that they present a tangible safety problem;
- » SHSOs may not be able to use AV or HAV communication messages unless they are approved by NHTSA.

AVs and HAVs present SHSOs with a range of opportunities to use their influence and reinforce their role as state highway safety leaders:

- » SHSOs should understand and document how automation through HAVs and ADASs fits into each state's behavioral safety mission. Each SHSO should ensure that all staff understand the importance and impact of automation on highway safety.
- » SHSOs should be proactive in encouraging the deployment of HAV and ADAS technology to improve highway safety as well as in promoting the safe operation of HAV and ADAS vehicles.
- » SHSOs should have a leadership role in state planning for HAV and ADAS testing and deployment to ensure that state HAV and ADAS policy is sound and improves safety.
- » SHSOs should build partnerships with other state organizations, law enforcement, prosecutors and judges, the AV and insurance industries and safety organizations to develop and implement sound AV policy and programs.

This expert panel's discussions, suggestions, conclusions and recommendations should help SHSOs achieve these goals.

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## Current State Automated Vehicle Activities

### LEGISLATION

Twenty-nine states and the District of Columbia have enacted legislation related to HAVs. Governors in 11 states have issued executive orders. Four states have both legislation and executive orders (NCSL, 2019). These laws and executive orders allow HAV deployment in 15 states and the District of Columbia and HAV testing in another 10 states, subject to various restrictions. In some states, testing on public roads is allowed without any specific legislation or regulatory action (IIHS, 2019).

### TESTING AND DEPLOYMENT

HAV testing or deployment on public roads is underway in at least 12 states as of June 2019.

**At least nine states have extensive HAV testing or deployment on public roads.** Each has a website maintained by the DOT or DMV that describes the state's HAV activities and provides information to HAV developers and the public.



**Arizona**'s regulations and procedures are described at the Arizona DOT website (ADOT, 2019). Arizona has created an Institute for Automated Mobility in which state government agencies, state universities and HAV developers will work cooperatively (Randazzo, 2018). Waymo has been testing HAVs in Arizona since 2016. It has begun charging passengers to use its driverless vehicles in four Phoenix suburbs (Sage, 2018).

**California** has hosted HAV testing since 2014. Requirements may be found at the California DMV website (California DMV, 2019). The website documents the companies that hold HAV testing permits: 62 for testing with a test driver and one for driverless testing as of January 2019. Two companies, Waymo and General Motors, together drove more than 1.6 million test miles in California in 2018 (Hawkins, 2019). The DMV website documents crashes in which HAVs were involved—167 as of June 27, 2019—and instances when the HAV technology was disengaged during testing. On April 12, 2019, the DMV published proposed regulations for testing and deployment of HAV trucks weighing less than 10,001 pounds on California's public roads.

**Colorado** established a Connected and Autonomous Technology program to serve as a liaison between the industry, the State and other relevant stakeholders for HAV testing and deployment, as described in the Colorado DOT website (CDOT, 2019). An HAV shuttle began operating in northeast Denver in February 2019 (Murray, 2019).

**Florida**'s HAV activities are described in general terms at the Florida DOT website (FDOT, 2019). The Autonomous Florida program of the Florida Chamber of Commerce encourages HAV testing and deployment (Autonomous Florida, 2019). Testing is underway in several locations, including Miami, by Ford (Small, 2018), and Gainesville, with an EasyMile shuttle (Caplan, 2018). In February 2019, the automated taxi company Voyage began free on-demand HAV taxi service in The Villages, a retirement community with 125,000 residents north of Orlando (Muller, 2019).

**Massachusetts** established its HAV working group in 2017 to encourage HAV development. The working group website also describes HAV testing procedures and regulations (MASSDOT, 2019). Three companies were testing in Boston as of May 2019 (Boston, 2019). Testing is planned or being considered in 14 other Massachusetts cities and towns (Bostonomics, 2018).

**Nevada** provides its HAV regulations and policies at the Nevada DMV website (DMVNV, 2019) and describes testing activities at the DOT website (Nevada DOT, 2019). Lyft and Aptiv began HAV shuttle service in Las Vegas in 2018. By May 2019 its 30-vehicle fleet had made 55,000 trips (Fisher, 2019).

**Ohio**'s HAV initiatives and testing requirements are described in the DriveOhio website (DriveOhio, 2019). May Mobility began operating an HAV shuttle in Columbus in 2018 (Henry, 2018).

**Pennsylvania**'s HAV testing guidance, platooning policy, task force, and activities are described in the Pennsylvania DOT website (PennDOT, 2019). As of February 2019, six

companies were authorized to test in various locations: Aptiv, Argo AI, Aurora Innovation, Carnegie Mellon University (CMU), Qualcomm and Uber. CMU has been testing their AVs on public roads since 2011.

**Washington** established an AV work group in 2018 (WTSC, 2019). AV developers are permitted to test either with or without a test driver after they self-certify that they can do so safely. As of June 2019, 11 companies had self-certified (ibid.). Waymo has been testing in Kirkland WA since 2016 (Banse, 2018).

**At least three other states host or have hosted on-road HAV testing in some locations.**

**Maryland** began operations of an Olli automated shuttle in the National Harbor area, just south of the District of Columbia, in 2019 (Zaleski, 2019).

**Michigan's** DOT established a Connected and Automated Vehicle working group in 2017 (CAR, 2019). HAV research and testing is conducted at the University of Michigan's Mcity (Mcity, 2019) and at other private sites (Pleskot, 2015). May Mobility began operating HAV shuttles on the University of Michigan campus and in downtown Detroit in summer 2018 (Carney, 2018; Noble, 2018).

**Texas** DOT formed a Connected and Autonomous Vehicle Task Force in 2019 (Descant, 2019). Waymo has been testing HAVs in Austin since 2015 and Drive.ai in Arlington and Frisco since 2018 (Weber, 2019)

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## **Automated Vehicles and State Highway Safety Offices: Challenges and Recommendations**

SHSOs have three major roles in preparing for HAVs: to help create sound HAV policy in the states, to raise the public's knowledge and promote the safe operation and potential benefits of HAVs, and to work with law enforcement to address their HAV challenges. This section discusses the first two roles; the following section discusses the third.

### **CHALLENGES INVOLVING AUTOMATED VEHICLE POLICY**

State leaders and officials first should realize that drivers currently are operating Level 1 and 2 AVs with a wide range of ADAS systems. HAVs soon will seek to operate on their roads as well. States should decide what actions are needed to address and prepare for HAVs.

They should examine what changes are needed in vehicle registration, driver licensing and traffic laws. States should determine what actions are needed by the criminal justice system, including state and local law enforcement, and the SHSO. They should realize that HAVs will never eliminate all crashes, so that states must continue to dedicate attention and funding to current highway safety problem areas including drivers impaired by alcohol and drugs, seat belt use, speeding, and distracted driving.

HAV developers will seek to test and deploy their vehicles across the nation. Each state has set or will set its own requirements for HAV testing and operation. This raises a two-way challenge. Developers need consistency across the states, so that HAVs can travel freely from state to state. States in turn need HAV developers to guarantee that all their vehicles will operate in a consistent and safe manner. Both states and HAV developers need consistent lines of communication with each other to document and resolve safety issues as they emerge. This challenge is substantial enough for the HAV developers who are traditional automobile manufacturers or large national businesses. It's even more acute for startup HAV developers that do not have existing relationships with even one state government, much less all 50, and that may not have the resources to develop these relationships.

**“HAVs will never eliminate all crashes, so states must continue to dedicate attention and funding to current highway safety problem areas.”**

The states also face a challenge in regulating HAV operations. NHTSA will continue to regulate vehicles through the Federal Motor Vehicle Safety Standards (FMVSS) and through defect investigations. However, NHTSA's HAV guidance 2.0 (NHTSA, 2017) states clearly that NHTSA will not regulate HAV operations but will provide voluntary guidance to HAV developers. The guidance lists 12 safety elements that developers should consider. It suggests, but does not require, that developers conduct Voluntary Safety Self-Assessments to report how they address these elements. The subsequent guidance 3.0 (NHTSA, 2018a) reaffirms this voluntary and non-regulatory strategy. It supports the development of voluntary technical standards and encourages developers to make their Voluntary Safety Self-Assessments public, as several already have done.

This means that the states will be responsible for regulating the operations of driverless Level 5 HAVs and Level 4 HAVs within their Operational Design Domain (ODD) as they now regulate drivers on the road. States should provide a consistent framework for HAVs across the states. HAV developers should create and abide by voluntary technical performance standards. NHTSA recognizes that these are difficult challenges. For the states, NHTSA and the United States Department of Transportation (USDOT) will “promote regulatory consistency so that automated vehicles can operate seamlessly across the Nation” (NHTSA, 2018a). For the HAV industry, NHTSA and USDOT “will build consensus among State and local transportation agencies and industry stakeholders on technical standards” (ibid.). Overall, NHTSA notes that “Only by working in partnership can the public and the private sector improve the safety, security, and accessibility of automation technologies and address the concerns of the general public” (ibid.). The true challenge is to achieve these goals: consistent HAV regulations across the states and voluntary technical standards applied universally across the HAV industry, both produced by effective partnerships.

The key to these challenges is partnerships: active, cooperative partnerships between AV developers and providers, states, law enforcement, and other stakeholders. These should be formed at the national, state, and local levels.

## **CHALLENGES INVOLVING THE PUBLIC**

The public has limited knowledge of AVs and HAVs: what they are and how they operate. Many drivers and road users don't understand how and when HAVs will be deployed and how HAVs obey traffic laws. They don't understand that there are different levels of AVs, that

drivers of Level 2 AVs must be in control at all times, and that drivers of Level 3 HAVs must be ready to take control at any time. A panel member noted that drivers do not understand many of the ADAS technologies already present in Level 1 and 2 vehicles and do not appreciate how they already are reducing crashes and saving lives. Another panel member pointed out that fatal crashes have occurred because drivers of Level 1 and 2 vehicles have disengaged from driving because they assumed that their vehicle was in complete control. The critical public challenge is to understand what the public needs to know about AVs and HAVs and how then to inform the public.

**“The public’s lack of understanding results in part because of the many mixed, confusing, or inaccurate messages regarding AVs and HAVs.”**

The public’s lack of understanding results in part because of the many mixed, confusing, or inaccurate messages regarding AVs and HAVs. A panelist observed that the media themselves often are as confused or uninformed as the public. Some messages are misleading, for example by suggesting that all HAVs will be able to drive themselves without any human involvement or that a complete fleet of HAVs will eliminate all crashes. A panelist suggested that the SAE Levels 1-5 (see pg. 2) can be confusing. While they may provide a useful initial classification, it would be valuable to develop AV terminology that’s both accurate and easy for the public to understand.

Given their unfamiliarity and confusion, it’s not surprising that surveys find that many drivers and road users aren’t enthusiastic about HAVs and don’t trust them. Another important public challenge is to gain the public’s trust in AVs so that their life-saving potential is not delayed. As one panelist observed, there’s no point in developing technology that no one wants to use.

**“There’s no point in developing technology that no one wants to use.”**

## **PUBLIC INFORMATION RECOMMENDATIONS FOR SHSOS AND OTHER STAKEHOLDERS**

The steps are straightforward: determine what information about AVs and HAVs drivers and other road users need to know; develop messages to convey this information; develop delivery methods to bring this information to the public. The messages must be clear, consistent and easily understood.

**Message content and development.** Some research is needed to determine precisely what information should be provided to specific audiences. Specific information needs probably include:

- » That AVs are appearing on the roads in stages: Level 1 and 2 AVs already are common; HAVs are appearing first in test fleets with backup human drivers, then in limited commercial operation, and only later may be available for private operation;
- » Information about new risks that HAVs may present to operators and other road users;
- » The different AV levels and the operator’s engagement and responsibility for each level;
- » How conventional vehicles should share the road with HAVs;
- » Information about HAV compliance with some traffic laws and whether this differs from how other road users comply;
- » Information for young operators, through driver education or otherwise;
- » Information for older operators, who may be reluctant to adopt the new AV technology.

Information and messages should be carefully developed and tested using focus groups and other methods. HAV experiences in test sites will provide natural laboratories for developing and delivering AV information. The information and messages should be careful not to overpromise the benefits of HAVs: they won't be publicly available for some time, their share of traffic on the roads will grow only gradually, and even if they become ubiquitous they won't eliminate all crashes, injuries and fatalities. Panel members stressed that drivers need to understand how to use current ADAS technology safely.

**Message characteristics.** Automated vehicle information, education and outreach to the public should be uniform, consistent, honest and trustworthy, regardless of how or by whom it is delivered. That means that it should be collaborative, developed or endorsed by all AV stakeholders, including the AV developers and providers, the states, law enforcement and NHTSA. It should contain information and messages for different audiences: different education and socio-economic levels, ethnicities, religions, ages and geographic areas of the country. Specific target audiences include children and youth, senior citizens, and customers of automobile dealers and rental car companies. Departments of Transportation, SHSOs, and law enforcement also need AV information and education. The product should be an information and education toolkit or library: a collection of materials and messages that can be used in different ways through different delivery methods by different organizations to provide uniform and consistent information.

**Message delivery.** AV information and messages should be delivered to many audiences, by sources that audiences trust, using many delivery methods, including various forms of social media. Panel members suggested that messages from celebrities, media figures, and influencers can attract attention.

One potential strategy is for movies, television, and other media to incorporate implicit AV messages in their programming. This strategy successfully promoted the use of designated drivers in the 1990s (Winsten, 2011). More recently, it promotes belt use by making sure that all car occupants seen in media are buckled up.

At the local level, messages delivered by local voices such as teachers and nurses often are trusted more than national messages. Panel members pointed out that AV information can be included in early education and novice driver training. Another member explained that the American Driver and Traffic Safety Education Association is incorporating automated vehicles into model novice driver training curricula. A third member proposed that the network of child passenger training technicians could disseminate AV information.

AV developers and distributors should provide AV training to automobile dealers and business AV purchasers so that they in turn can provide the needed information to those who own or operate AVs. This is a critical point for information and education. AV operators should understand clearly their AV's capabilities and the responsibilities of those who drive or ride in it. It's not enough to give the operator a thick technical manual. Some hands-on training may be called for. These issues will be even more critical as AVs pass to second owners or are used as rental vehicles.

**“AV developers and distributors should provide AV training to automobile dealers and business AV purchasers so that they in turn can provide the needed information to those who own or operate AVs.”**

Finally, “seeing is believing”: AV messages and information can be conveyed through demonstrations where the public can see and ride in AVs. HAV pilot programs do this well. The AV community should seek out a wide variety of opportunities to demonstrate HAVs: at vehicle-related events such as NASCAR and other races, vehicle shows, concerts, sports events and other public gatherings.

**Leadership on public engagement.** Producing and delivering collaborative AV information and messaging requires national leadership. That should come from an active partnership of AV stakeholders, including:

- » The AV industry
- » NHTSA and the USDOT
- » The states through GHSA, the American Association of Motor Vehicle Administrators (AAMVA), the American Association of State Highway Transportation Officials (AASHTO), and other state agency associations
- » The criminal justice community, through the International Association of Chiefs of Police (IACP), the National Sheriffs’ Association (NSA), and the National Traffic Law Center, and
- » Other national safety and consumer organizations

Broad partnerships have arisen previously in times of crisis and have quickly provided information that changed the public’s behavior. A panel member cited the national information campaign promoting “kids in back” in response to the deaths of front-seated children from air bags in the 1990s. AVs require more complex messaging, involving more partners, and currently without the impetus of a crisis. But the partnerships are needed; if they can be formed they will aid AV deployment substantially and will save many lives.

There is no current inclusive organizational framework to develop collaborative AV and HAV messages and an information toolkit or library. Two organizations, PAVE and the Road to Zero, may be candidates.

» **The Partnership for Automated Vehicle Education (PAVE)** is a coalition of AV industry and nonprofit institutions whose goal is to inform the public about automated vehicles and their potential (PAVE, 2019). It was launched in January 2019 and currently has about 50 members, including GHSA. Industry members include traditional automakers from the United States and around the world, auto component makers, startup technology companies, established tech firms, and insurance companies. Nonprofit members include disability advocacy and safety groups. PAVE is led by a rotating 25-member steering committee with two co-chairs. The National Safety Council (NSC) is the permanent co-chair and Audi was the rotating co-chair in Spring 2019.

PAVE’s activities are to conduct public education on AVs through an educational website and social media channels, AV demonstrations, policymaker workshops and dealer education.

» **The Road to Zero (RTZ) Coalition** was launched in 2016 by NSC, the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA) and NHTSA with the goal of eliminating roadway deaths within 30 years (NSC, 2019). RTZ currently has about 900 coalition members, including GHSA. RTZ is led by a steering group of 17 organizations chaired by NSC, with NHTSA, FHWA and FMCSA as advisory members.

RTZ's activities are spread across a wide range of highway safety areas, including impaired and distracted driving, occupant restraints, speeding and safety infrastructure. It awarded \$1 to \$1.5 million in grants annually in 2017-2019 for activities in these areas, with funds provided by USDOT. It has no current AV education activities but includes among its goals "developing a strategic plan for self-driving cars and human-vehicle-roadway communication" (ibid.).

Developing the AV messages and information toolkit will require substantial resources. No one partner should be expected to fund the effort completely. A panel member noted that SHSOs do not have the capacity to develop these resources themselves. Another member suggested that NHTSA could take the lead, either on its own initiative or as directed by Congress.

The initial challenge is clear: to form and fund a collaborative partnership. The resulting challenge is to develop, test, produce and implement an AV toolkit that will deliver AV information and messaging to many audiences with a unified, honest and trustworthy voice.

**"No one partner can or ought to develop and deliver AV safety messages completely."**

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## Automated Vehicles and Law Enforcement: Challenges and Recommendations

Law enforcement and the broader criminal justice system will interact with AVs on the road, at the roadside and after a crash. Each presents challenges. More broadly, law enforcement and criminal justice practitioners should be active participants in developing AV policy at the national, state and local levels.

AAMVA's Autonomous Vehicle Working Group examined the impact of HAVs on the motor vehicle administrative and law enforcement communities. Its report (AAMVA, 2018) discusses 11 areas of concern for law enforcement and the criminal justice system, eight of which are directly relevant to this report. They are referenced here by their section in the AAMVA report: for example, AAMVA 6.10 refers to first responders identifying HAVs.

Panel members noted some ways in which the AV industry is engaging with law enforcement in HAV test sites either by conducting training or by assisting with crash investigations. Some HAV developers have implemented law enforcement interaction plans in their HAV test sites.

### CHALLENGES INVOLVING AV POLICY

The criminal justice system and SHSOs should participate actively in developing HAV testing

and deployment policy, regulations, and technical standards at both state and national levels. Specific issues to be addressed include traffic laws, vehicle registration, crash reporting, and vehicle inspection and testing in states that require them. Some cities may issue their own HAV regulations; again, the criminal justice system and SHSOs should be active partners.

## CHALLENGES INVOLVING AV OPERATIONS

**Identifying HAVs on the road:** Officers must be able to identify quickly if a vehicle on the road is an HAV. This is necessary for officer safety when an HAV is stopped for a possible traffic violation or is involved in a crash. It also would be useful to be able to identify an HAV when it is in motion, so officers and other roadway users can anticipate how the vehicle will operate. AAMVA 6.10 recommends permanent labels on an HAV's sides and rear. A challenge is to assure that all HAVs are identified uniformly in the absence of any NHTSA labeling requirements. In the future, a uniform national standard may be appropriate, similarly to AAMVA's national license plate standard (AAMVA, 2016).

It also would be useful to identify an HAV's level and to identify in real time whether an HAV is under automatic or driver control. Some HAV developers are experimenting whether this can be done with external cues such as colored lights, though panel members pointed out that any method involving lighting must be consistent with existing vehicle lighting regulations. As discussed previously, HAVs and drivers operate differently in some situations. Conflicts may arise if officers or other road users assume that a vehicle is under automatic control when it is not, or vice versa.

**“Police should be able to identify an HAV's level and to identify in real time whether an HAV is under automatic or driver control.”**

**Communicating with HAVs on the road:** Officers must be able to direct HAVs in traffic and to require an HAV to pull to the side of the road. HAVs must respond appropriately to temporary traffic controls and unusual roadway hazards and situations (AAMVA 6.8). The challenge for AV developers is to build this capacity into their HAVs and continually to improve it as their HAVs experience new situations.

**AV performance with regard to traffic laws:** Traffic laws present two challenges. First, some current laws should be changed to allow the operation of completely automated Level 4 HAVs within their ODD and Level 5 HAVs. Examples include laws regarding distracted or impaired driving and following too closely, and other laws that state or imply that a human is controlling the vehicle or that preclude certain automated driving situations.

The second challenge is to reconcile conventional driving practices with HAV compliance with traffic laws. As noted previously, current HAVs strictly obey all traffic laws while most drivers do not. A mix of law-abiding HAVs and law-bending conventional-driver vehicles would not produce smooth traffic flows; it likely would produce both road rage and crashes. Some have suggested that HAVs will be the leaders on traffic law compliance and that over time all drivers will fall into line and obey all laws. Others have argued that HAVs should follow current driving practices rather than complying with the letter of the law; for example, that HAVs should match the speed of freely-flowing traffic on interstates and other controlled-access roads.

**At the roadside:** At the roadside, after a traffic stop or a crash, law enforcement and first



responders must be able to identify an HAV, determine if it was operating in automated mode, and disable the automated system (AAMVA 6.6, 6.7). The challenge is to incorporate uniform procedures for these three tasks across all HAV developers and to train law enforcement and first responders.

**Crash reporting:** When an AV is involved in a crash, law enforcement will complete their usual crash reports. In addition, it will be extremely useful if the crash report identifies the vehicle as an AV of a given level and identifies whether the vehicle was in automatic or manual mode for a period of time before the crash. At the very least, states should incorporate the guidance for coding AV data from USDOT’s Model Minimum Uniform Crash Criteria 5th edition (MMUCC, 2017).

Finally, it will be extremely useful if data from an AV’s Event Data Recorder (EDR) and other AV vehicle data can be accessed by law enforcement. These data have the potential to provide critical information for the crash investigation, for crash records and for determining crash causation. In addition, the data will be useful to AV manufacturers, to help improve the AV’s software and reduce future crashes, and to insurance companies. AAMVA recommends automakers provide law enforcement access to at least 30 seconds of pre-crash and post-crash data (AAMVA, 6.1). The challenge is to ensure the necessary data can be provided in a non-proprietary format and that AV manufacturers and government agencies can agree on a system to make their data securely and promptly accessible to law enforcement.

**“AV data have the potential to provide critical information for the crash investigation, for crash records and for determining crash causation.”**

A panel member reported that the SAE Event Data Recorder Task Force is developing a standardized data set for these purposes. Another panel member noted that law enforcement agencies have quite different capabilities for dealing with EDR and similar data and that smaller agencies may need some assistance. A panel member predicted that judges will need training to prepare them to issue search warrants for EDR and other AV digital evidence.

**Fault and liability:** If an HAV is at fault in a crash, the challenge is to determine who or what can be charged and is liable for any damages. A panel member urged that liability guidelines be established and well-known, so that officers at the roadside have clear rules for issuing citations.

It’s generally agreed that if the driver is controlling the AV, either directly in Levels 1 and 2 or is responsible for taking control as required in Level 3, then the driver is responsible for its operation and can be charged. For a Level 4 HAV within its ODD or a Level 5 HAV, operating in automated mode, there are several possibilities. AAMVA 6.5 recommends that the registered HAV owner be responsible. Others have suggested that the HAV’s manufacturer be responsible under product liability law.

## OPERATIONAL RECOMMENDATIONS FOR LAW ENFORCEMENT AND SHSOS

**Policy and training needs.** Law enforcement and criminal justice needs are quite clear.

- » A uniform method by which law enforcement and other road users can identify an HAV on the road.
- » Assurance that all HAVs will recognize and respond appropriately to direction from law enforcement, temporary traffic controls, and unusual roadway and traffic situations.
- » Agreement from the states, AV developers and providers, and NHTSA on how to reconcile conventional driving practices with HAV's strict compliance with traffic laws
- » Uniform procedures and training for law enforcement and first responders in dealing with an AV at a crash scene.
- » Uniform methods for law enforcement to access appropriate non-proprietary EDR and other vehicle data from an AV after a crash.
- » Agreement on responsibility for AV operations and crashes for a Level 5 HAV and a Level 4 HAV both within and outside its ODD.
- » Mechanisms for law enforcement to acquire and objectively analyze vehicle data relevant to determining crash responsibility.

These operational needs depend on resolving two critical structural issues. States may need to change their traffic laws to allow automated operation by HAVs. Issues include laws governing distracted and impaired driving and following too closely. States must determine and must inform law enforcement, prosecutors and judges about how traffic law violations and liability for crash damages apply to HAVs operating automatically.

**Uniformity and standardization.** The safety community should collaborate to establish uniform and standard national methods across all HAVs for identifying an HAV, determining automated or driver control, communicating with it, disabling it at roadside and extracting data from it. The necessary information should be provided to law enforcement and first responders through standard training and best practices guides. Law enforcement, prosecutors, judges and juries need standard information on how HAVs do or do not comply with traffic laws.

**Training delivery.** AV information and training should be developed with the participation of appropriate national organizations: IACP and NSA for law enforcement; the National Association of State EMS Officials, the National Fire Protection Association, and other national first responder organizations; the National Traffic Law Center and the National Judicial College for prosecutors and judges. State law enforcement, first responder, prosecutor and judicial organizations then can distribute it. To be effective it must be delivered locally through police agencies, ambulance and other first responder services, and courts.

Currently, there is no nationwide law enforcement training body. Some national law enforcement organizations, such as IACP, offer training that local agencies may use. Many first responders are volunteers and may not have access to the same training resources as

law enforcement. A panel member recommended the GHSA create a best practice program on HAV safety for first responders. The SHSOs can further assist delivery through their law enforcement liaisons and traffic safety resource prosecutors. A panel member noted that it may be useful to offer continuing legal education credit for appropriate training courses.

**Leadership on engagement with new technology.** Law enforcement leadership is key. First, law enforcement must raise the priority of preparing for AVs on their agenda: currently it's not on the radar screen in many states. Next, law enforcement should participate actively in state AV task forces. Law enforcement must engage with AV developers and providers for AV testing and deployment and should develop an AV interaction plan. Finally, a panel member suggested it would be very useful for a state to have a single law enforcement point of contact for issues arising from testing and deployment, to provide uniform and consistent information and to resolve issues for AV developers and providers, the media, and the public. States may wish to designate an official in the Department of Public Safety or State Police to carry out this role.

Achieving uniformity across states in traffic law changes and accommodation to the laws by AVs will require cooperative and collaborative national leadership involving AV developers, law enforcement, the states and USDOT. Collaboration will also be key to achieving uniformity across AV developers in identifying AVs, communicating with them, allowing law enforcement (and other road users) to determine whether they are controlled automatically or by a driver, disabling an HAV and extracting data from it at the roadside, and how HAVs will operate with regard to traffic laws.

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## Major Themes and Conclusions

Four themes characterize the interactions of AVs with states and law enforcement.

- » **Complexity:** The issues are complex. They involve many groups – AV developers and providers, states, law enforcement and first responders, and the federal government – at local, state, and national levels, groups that are composed of many parts that need to agree on group decisions.
- » **Communications:** Understanding the issues and how they affect these groups requires effective, honest, and straightforward communication.
- » **Cooperation:** Resolving the issues and producing the needed information, training, and best practices requires the cooperative efforts of all involved groups. No one group or organization can do it alone or can impose its will on the others. Success or failure will depend on establishing and maintaining effective partnerships.
- » **Consistency:** AVs must operate consistently and meet consistent and uniform performance standards; information and training must be delivered consistently nationwide.

Cooperative action is needed now rather than later. Cooperative partnerships can produce the toolkit or library of AV messages and materials, agreed to by all, that can be used by all to educate everyone consistently. They can produce uniform guidelines to provide consistency in laws, policies and practices across the states, AV developers and providers, and law enforcement agencies. The benefits will be substantial. If the opportunity is missed, there's likely to be a patchwork of inconsistency and confusion that will only create problems, slow AV deployment, and produce unnecessary crashes and injuries. The keys are leadership, communication and cooperation.

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## Summary of Recommendations for State Highway Safety Offices, Law Enforcement and GHSA

### For SHSOs and GHSA

- » Promote advanced vehicle technologies – HAVs and ADASs – that promise to improve driving and reduce crashes.
- » Continue to address current behavioral safety problems, including impaired and distracted driving, safety belt use, and speeding, for the foreseeable future. It will be many years before AVs reduce these problems significantly.
- » Participate actively in developing a toolkit or library of AV information and messages agreed to by all stakeholders that can be used by GHSA, NHTSA, SHSOs, safety groups, the AV industry and AV dealers.



### For SHSOs

- » Understand how HAVs and ADASs fit into their behavioral safety mission.
- » Establish HAV testing and deployment as a priority area; encourage and promote HAV and ADAS testing and deployment.
- » Participate actively in leadership roles in state AV working groups.
- » Build partnerships with other state organizations, law enforcement, prosecutors and judges, the AV and insurance industries, and safety organizations to understand issues and concerns and to develop and implement sound AV policy and programs.
- » Serve as a trusted source of AV information for organizations in the state and for the public. Deliver AV information and messages to the public.
- » Consider assigning a SHSO staff member as a single point of contact on AV issues.

### **For law enforcement, first responders, and criminal justice**

- » Establish HAV testing and deployment as a priority area.
- » Participate actively in state AV working groups.
- » Establish a single law enforcement point of contact for AV issues within the state.
- » Coordinate closely with all HAV testing and deployment in the state.
- » Establish policies and protocols for interacting with HAVs. Determine the training needed by patrol officers and first responders for dealing with HAVs; train officers and first responders as appropriate.
- » Provide appropriate AV information to prosecutors and judges who deal with traffic crashes.

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# Appendix

## Automated Vehicle Safety Expert Panel: Engaging Drivers and Law Enforcement

### AGENDA

Facilitator: Karen Sprattler, Kimley-Horn

8:00 am	Breakfast/Registration
8:30 am	<b>Welcome</b> <ul style="list-style-type: none"><li>» Jonathan Adkins, GHSA</li><li>» Vicki Harper, State Farm</li></ul>
8:45 am	<b>Introduction to the State Highway Safety Offices and SHSO Role in Automated Vehicle Safety</b> <ul style="list-style-type: none"><li>» Lora Hollingsworth, Florida DOT</li></ul>
9:00 am	<b>Discussion: Framing the Challenges</b> <ul style="list-style-type: none"><li>» Miriam Chaum, Uber</li><li>» Dr. David Harkey, IIHS/HLDI</li><li>» Anne-Marie Lewis, Auto Alliance</li><li>» Staff Sergeant Terry McDonnell, New York State Police</li><li>» Kelly Nantel, National Safety Council</li><li>» Adam Shapiro, ASPR</li></ul>
10:30 am	Break
10:45 am	<b>Discussion: Public Outreach and Programs</b>
12:15 pm	Lunch
1:15 pm	<b>Discussion: Criminal Justice Engagement</b>
2:45 pm	Break
3:15 pm	<b>Discussion: Synthesis</b>
5:00 pm	Adjourn

### GOALS

Automated vehicles (AVs) already are appearing on our roads. They raise important issues for drivers, other road users, and law enforcement. This expert panel's goal is to pool the collective members' experience and views on the most important issues that need to be addressed by State Highway Safety Office (SHSO) public outreach programs, law enforcement, and others. The panel's results should frame the important issues and propose actions steps to address each issue—what to do and who should do it—for the following five audiences.

1. Recommendations for SHSOs on behavioral programs
2. Recommendations for law enforcement on preparing for new technologies
3. Recommendations for industry
4. Recommendations for safety advocates on initiatives to prepare for AV behavioral impacts
5. Recommendations for state and local policymakers on initiatives to prepare for AV behavioral impacts

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# Appendix

## Automated Vehicle Safety Expert Panel: Engaging Drivers and Law Enforcement

### ATTENDEE LIST

Organization
Advocates for Highway and Auto Safety
American Association of Motor Vehicle Administrators
American Association of State Highway Transportation Officials
American Property Casualty Insurers
ASPR
Auto Alliance
Cypress Group
Florida DOT; GHSA
FMCSA
Ford Motor Company
Foundation for Advancing Alcohol Responsibility
GHSA
Global Automakers
Highway Safety North
Insurance Institute for Highway Safety
International Association of Chiefs of Police
Kimley-Horn
Lyft
Massachusetts Executive Office of Public Safety; GHSA
National Association of Mutual Insurance Companies
National District Attorneys Association
National Safety Council
National Sheriffs' Association
New York State Police
NHTSA
Safe Kids Worldwide
State Farm®
Uber
Virginia Highway Safety Office; GHSA
Washington Traffic Safety Committee; GHSA