2021-2025

MDOT SHA Connected and Automated Vehicle Implementation Plan

JUNE 2021

MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Acknowledgments

Disclaimer: *This document is not representative of all Maryland nor of the entire Maryland Department of Transportation (MDOT). The strategies outlined in this document represent the MDOT State Highway Administration areas of responsibilities only.*

For questions or comments about the broader Maryland CAV program, please contact marylandcav@mdot.maryland.gov.

The development of this **2021-2025 MDOT SHA Connected and Automated Vehicle Implementation Plan** would not have been possible without the following stakeholder input. We thank the following for making this document a reality, from reviewing reports and brainstorming ideas, to outreach and cross-agency collaboration – and for championing the strategies beyond the release of this document.

MDOT SHA
- Internal CAV working group members
- Senior management team and staff

The Secretary's Office (MDOT)

U.S. Department of Transportation, Federal Highway Administration

The University of Maryland, Center for Advanced Transportation Technology Laboratory

Maryland Metropolitan Planning Organizations
- Transportation Planning Board (TPB)
- Baltimore Regional Transportation Board (BRTB)
- Hagerstown Eastern Panhandle Metropolitan Planning Organization (HEPMPO)

Private Industry
- Gannett Fleming
- Johnson Mirmiran & Thompson
- Texas A&M Transportation Institute
- WSP USA

If you have any questions about this document, please contact the MDOT SHA CAV program manager at shacav@mdot.maryland.gov.

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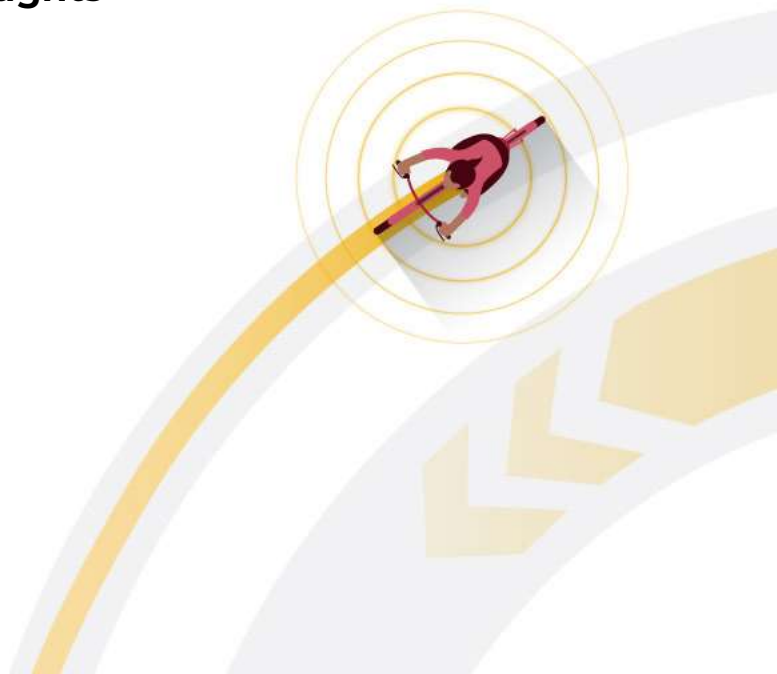
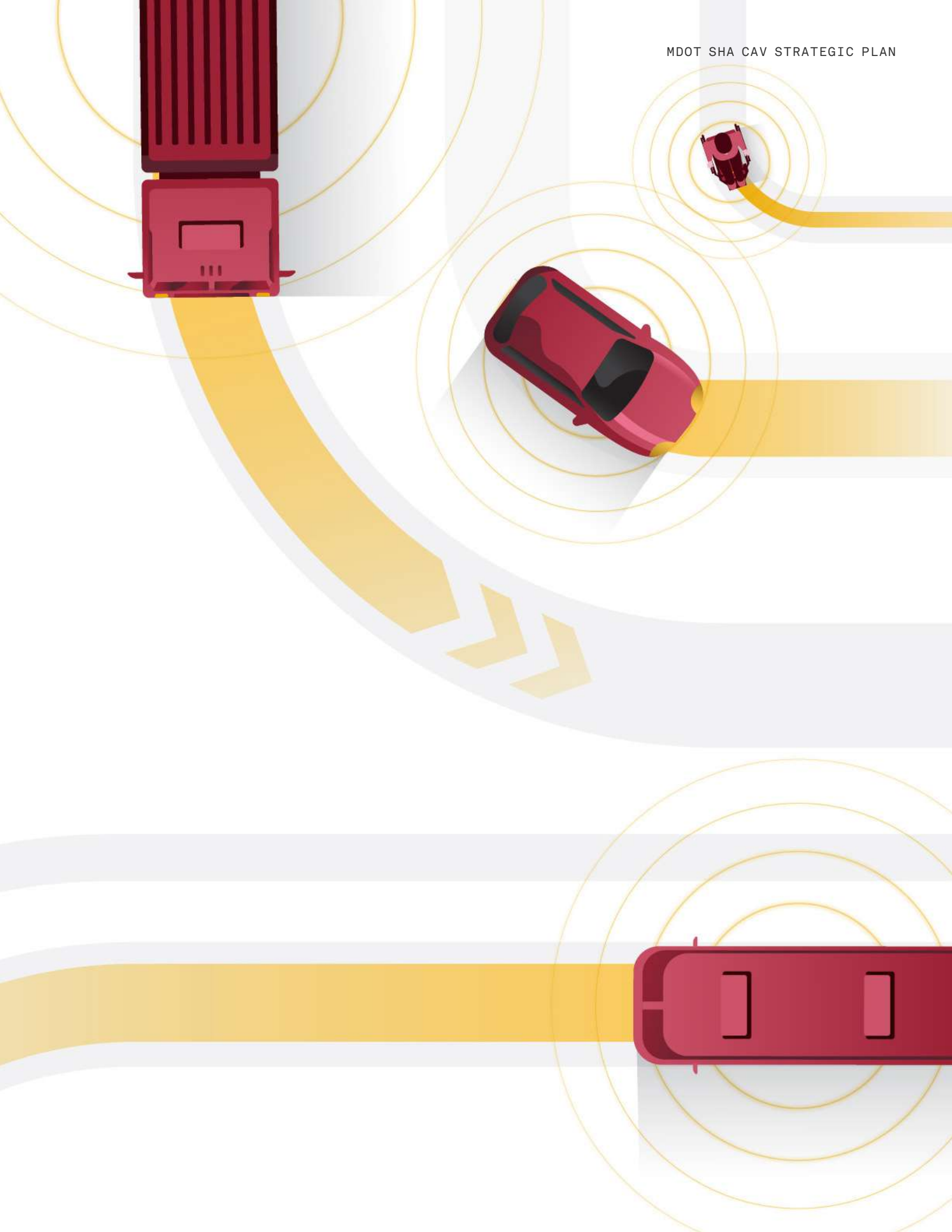





EXIT 12
Watkins Mill Rd

Messages from the Secretary and Administrator

Gregory Slater
SECRETARY

Maryland Department of Transportation

Even before worldwide pandemics, our transportation landscape was changing. Micromobility solutions were on the rise, e-commerce was growing exponentially, and crowdsourced data was the new "gold" in decision making. We have and continue to be in a constant state of flux. It is why the Maryland Department of Transportation supports its Transportation Business Units in developing implementation plans to build on our past momentum, create a vision, and put us on the leading edge of innovation. The willingness to be objective and seek critical feedback about how to improve our transportation landscape continues to position Maryland to meet our communities' future needs. I am proud to see the Connected and Automated Vehicle strategies proposed by the Maryland Department of Transportation State Highway Administration as it continues to support the broader Maryland CAV program. No matter what the future of transportation ends up looking like – autonomous flying vehicles or ground vehicles alike – Maryland will continue to be a leader in advancing accessible, automated, connected, equitable, and shared mobility solutions. By working together and continuing to make progress, there are no limits to what we can deliver to our customers.

Tim Smith
ADMINISTRATOR

Maryland Department of Transportation State Highway Administration

The economic vitality of the State, and the ability to create better opportunities for our citizens, are closely tied to transportation, and the Maryland Department of Transportation State Highway Administration (MDOT SHA) supports a new era of mobility with Connected and Automated Vehicles technology. COVID-19 may have affected how we work, how we see our families, and whether we go out and enjoy activities, yet through these challenging times we found an opportunity to rethink what the future of transportation looks like. With the release of this **2021-2025 MDOT SHA Connected and Automated Vehicle Implementation Plan**, we support our agency's mission and the broader Maryland Connected and Automated Vehicle Strategic Framework. In doing so, we make our State accessible to everyone — whether by car, bus, train, bicycle, e-scooter, or on foot. We ensure a safe, accessible, reliable, and efficient transportation ecosystem. We know there is significant room to innovate in the realm of Connected and Automated Vehicles to meet those goals. We will continue to work with our partners and provide annual updates on this Plan as we progress with its implementation.

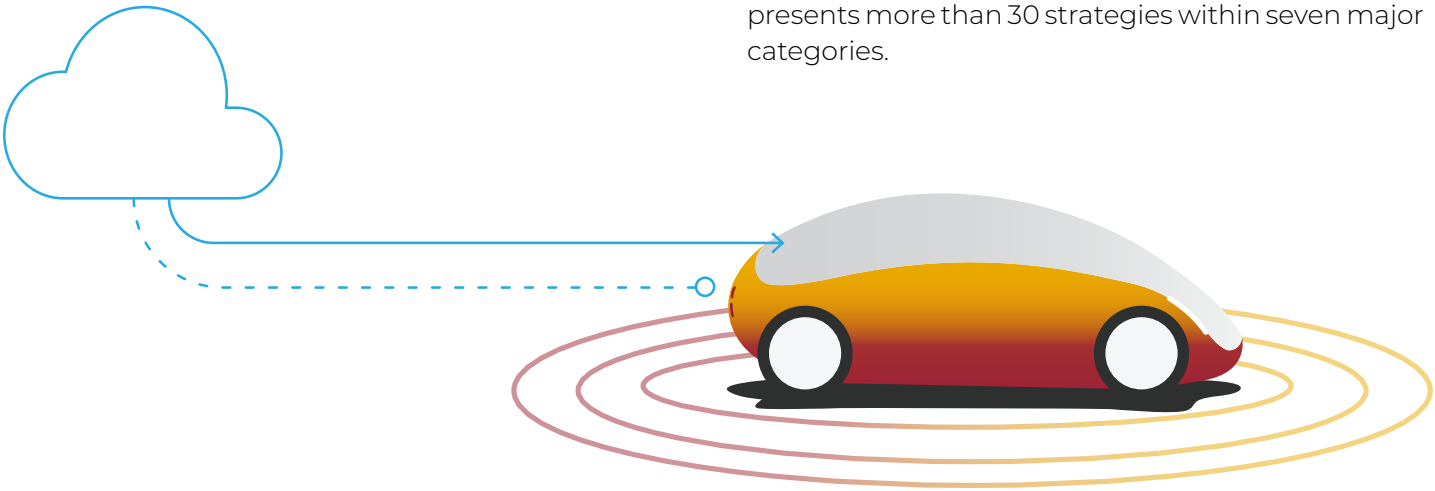
Executive Summary

> Maryland's Vision for Connected and Automated Vehicles (CAV) is to uphold and enhance a Safe, Efficient, and Equitable transportation future by delivering collaborative and leading-edge CAV solutions. Maryland is open for business and eager to realize the life-saving and economic benefits of CAV technology, while ensuring safety for all. We are embracing CAV technology and innovation through continuing collaboration with partners interested in researching, testing, and implementing CAVs in Maryland.

Source: Maryland CAV Working Group

The Maryland Department of Transportation (MDOT) led the development of the Maryland-wide CAV vision through statewide stakeholder input, of which MDOT State Highway Administration (MDOT SHA) was integral in helping to establish. As our State pushes the envelope on innovation, agencies like MDOT SHA are well positioned and hold the responsibility to prepare themselves and their stakeholders for the future of transportation. Even when faced with public health, safety, economic, environmental, funding, security, or other constraints and challenges, Maryland's citizens continue to rely on the transportation network on many levels. This responsibility falls squarely on MDOT SHA and means we aim to support CAV technologies for continued economic growth and progress toward a bright and equitable future.

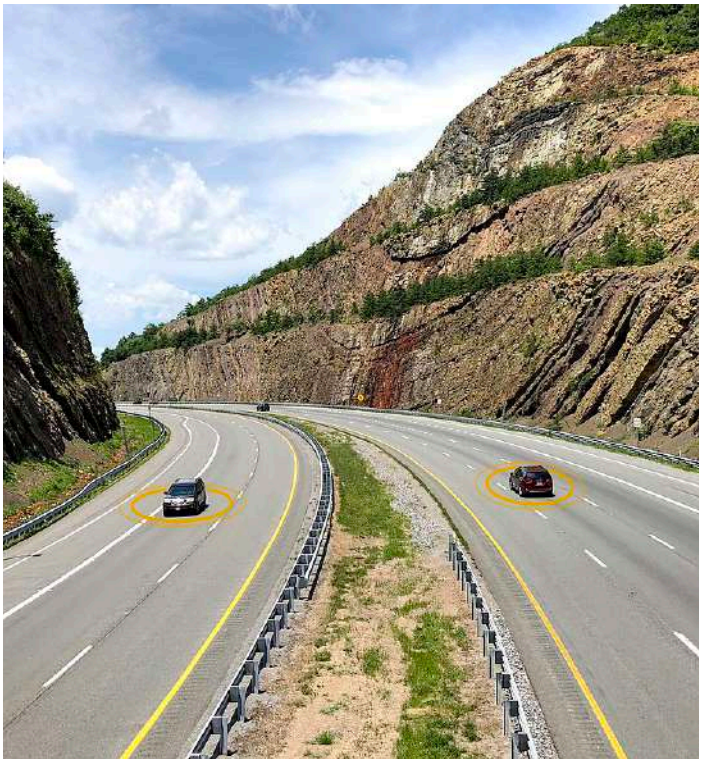
The 2021-2025 MDOT SHA CAV Implementation Plan upholds Maryland's vision of a future encompassing CAV and serves to support the 2020 Maryland CAV Strategic Framework. It focuses solely on MDOT SHA's area of responsibility, including non-tolled State arterials and highways. Accomplishments to date and extensive stakeholder outreach helped to formulate the Plan, which outlines five main objectives and presents more than 30 strategies within seven major categories.



Plan Objectives

CORE MDOT VALUES

- Safety
- Equity
- Economic Vitality
- Efficiency
- Agency Readiness



35 Strategies in 7 Categories

- Partnerships and Collaboration
- Workforce
- Policies, Laws, and Contractual Mechanisms
- Foundational Planning
- Engineering Design
- Early Testing and Deployment
- Software, Cybersecurity, and Artificial Intelligence

Maryland's vision for the future of transportation is bold and unwavering. While uncertainty remains about the exact where and how CAV will be implemented, MDOT SHA fundamentally believes we should proactively prepare for the integration of this life-changing technology – not just react to it after the fact. The Plan establishes that CAV solutions should be integrated into the agency, not advanced separately to our core functions. MDOT SHA plans on tracking this Plan's progress annually, developing new strategies or goals as the years and CAV technology evolve.

Introduction

The Maryland Department of Transportation State Highway Administration (MDOT SHA) recognized in 2016 that Connected and Automated Vehicle (CAV) technology would transform mobility, and began to set forth a strategic plan and vision for our agency and its stakeholders. During the next three years, MDOT SHA advanced the CAV technology concept from an idea to an established and successful program. Our momentum was realigned when, in 2020, the impacts due to the COVID-19 pandemic triggered widespread and fundamental changes to our transportation ecosystem. Shifts to work-from-home along with staggered scheduling, increased e-commerce, and resulting demands on delivery providers were some of the immediate impacts to which our agency needed to respond. Post-pandemic, commute and travel patterns may change workplace and land use patterns that previously had been considered stable. The silver lining to this crisis is shown in how quickly we can embrace innovation to meet our customers' needs.

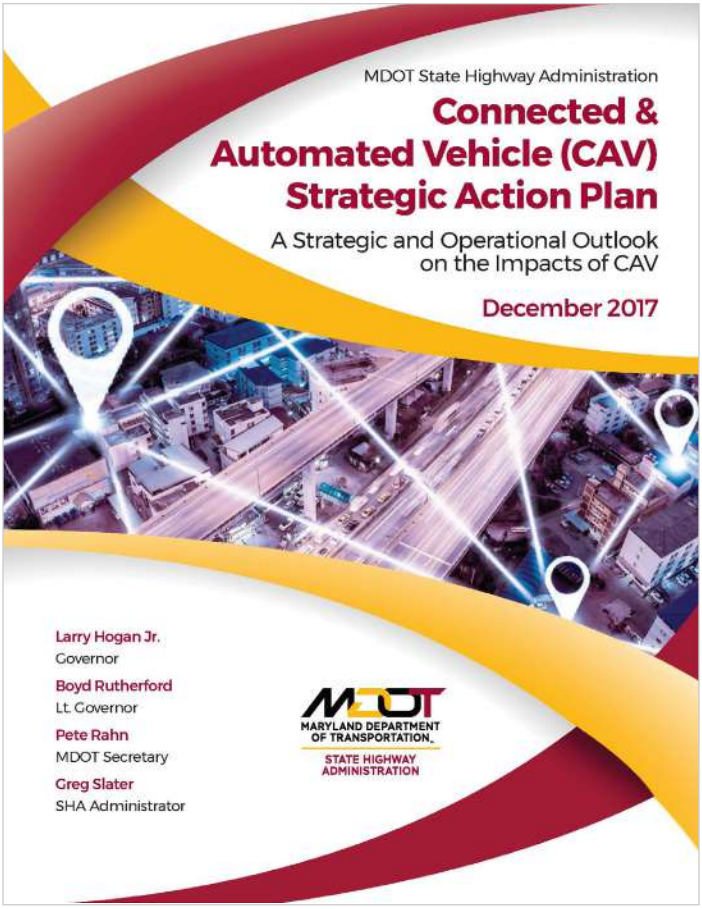
The result of the pandemic could lead to a future system where public health concerns fuel an increased dependency on single-occupancy vehicles and thus increased congestion, or, agencies such as MDOT SHA can confront these changes with a strategic vision for investing in and preparing for a smarter, integrated, and multimodal network that improves mobility and efficiency across the system. Addressing and adapting to the dramatic change in travel and goods movement presents an opportunity to rethink our transportation priorities and renew our commitment to innovative strategies and solutions. Now is the time to prioritize preparations for CAV technology such that a completely altered landscape of travel demand patterns is ready to realize and leverage a connected and automated future. Spurred by the opportunities presented at this critical juncture, and by the 2020 release of Maryland's CAV Strategic Framework[1], MDOT SHA posed the challenge: *how can connected and automated vehicles meet the needs of our communities?* The resulting answers generated a list of implementation strategies compiled in this 2021-2025 MDOT SHA CAV Implementation Plan (forthwith known as Plan). The Plan focuses on the components and infrastructure under MDOT SHA's area of responsibility, which covers non-tolled State arterials and highways, and serves to equip MDOT SHA with a set of proactive goals, strategies, and considerations that aim to enhance and leverage the benefits of CAV technology for our customers. **To be clear, initiatives in this document are not all encompassing of the entire MDOT nor of the broader statewide Maryland CAV program.**

[1] Maryland CAV Strategic Framework [Link]

Accomplishments to Date

Understanding where to go next also means recognizing where we have been. In 2017, MDOT SHA initiated and delivered the agency's first Connected and Automated Vehicle Strategic Action Plan. The document recommended more than 35 initiatives to be undertaken immediately to launch MDOT SHA into the world of CAV. MDOT SHA made significant progress in the first year of implementing that plan by advancing 26 of the 35 actions, which have subsequently been tracked through annual accomplishments reports[2]. By early 2019, the original group of dedicated CAV subject matter experts also expanded to almost 50 individuals, with new and diverse opinions spanning from legal, to maintenance, to district representation.

MDOT SHA aims to build on these accomplishments to advance CAV technology within the State. This Plan outlines MDOT SHA implementation goals and more than 30 strategies to ensure our agency, but more importantly, our State, can better prepare and benefit from CAV technology. The following pages summarize the timeline of MDOT SHA CAV high-level achievements from its inception in 2016 through 2020.



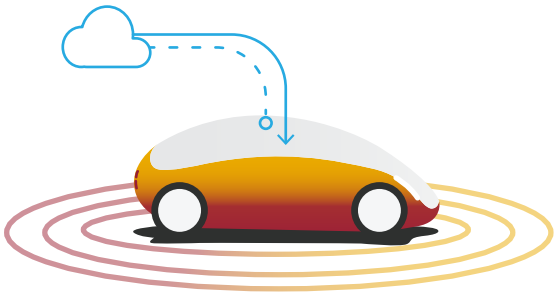
[2] 2018 Accomplishments Flyer [Link] and 2019 Accomplishments Flyer [Link]

2016

- MDOT SHA CAV working group is established
- CAV included in TSMO Strategic Action Plan [Link]
- Led Maryland's response to Federal AV Proving Ground RFP [Link]

2017

- Released the first MDOT SHA CAV Strategic Action Plan [Link]
- Committed to SPaT technology deployment on US 1 in Howard County



2018

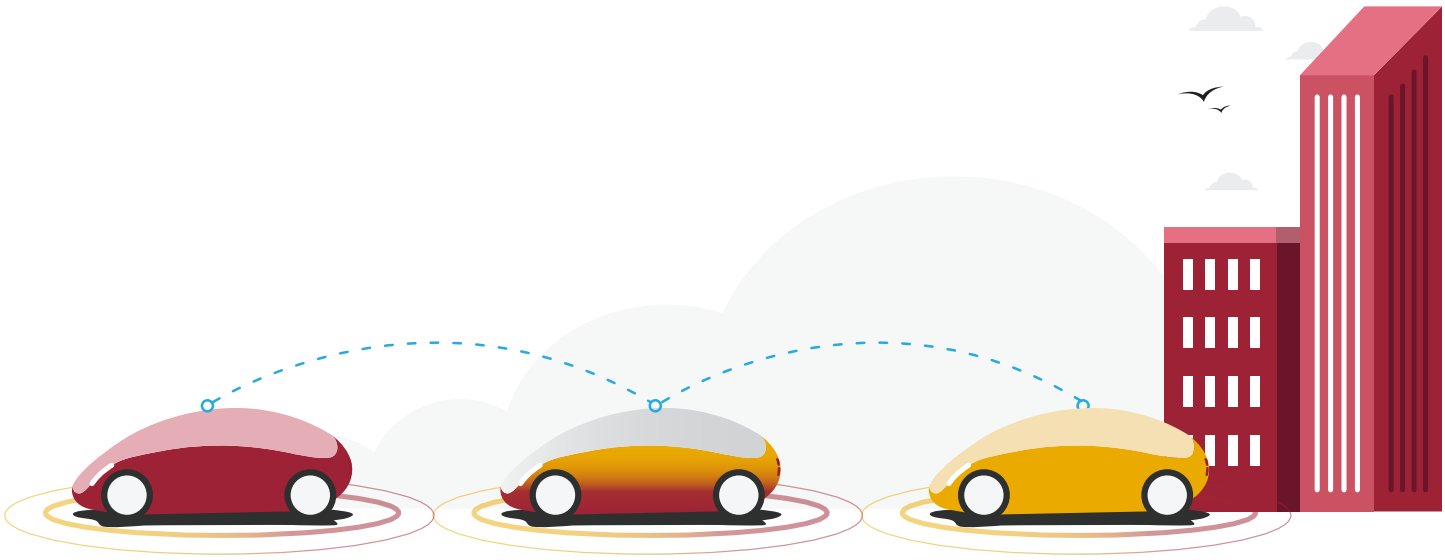
- Dynamic US-wide CAV Public Policy Map developed to track national legislation {Link}
- CV technology dashboard created and planning level cost estimates generated for Consolidated Transportation Plan projects [Link]
- Created the LETS dashboard for MDOT to assist AV testing in Maryland [Link]
- Expanded national presence (e.g. AASHTO, NOCoE, CAT Coalition, etc.)
- Updated TSMO Strategic Action Plan with new CAV initiatives [Link]
- See details of 2018 Accomplishments Here

2019

- Expanded the internal CAV working group to include new stakeholders, such as pavement design, legal, maintenance, and others within the agency championing innovation
- The Connected and Automated Transportation Systems (CATS) Division is formalized to lead CAV efforts at MDOT SHA
- The first agency-wide webinar on CAV is given to MDOT SHA staff and the first interactive online CAV 101 training application for employees is released
- Planning staff begin modeling CAV in the Maryland Statewide Transportation Model and in microsimulation (VISSIM)
- Received a $40,000 State Transportation Innovation Council (STIC) Grant to deploy connected vehicle technology for vulnerable roadway user safety
- Connected Vehicle Capability Maturity Model workshop completed to help direct priorities for the coming years
- Created a signage template for companies to use when testing autonomous vehicle on public roadways
- Performed a TSMO workshop for freight focused on CAV and Freight Traveler Information Systems/Truck Parking
- See details of 2019 Accomplishments Here

2020

- Piloted HAAS Alert connected vehicle technology on three types of fleet vehicles
- 50+ MARWIS pavement sensor data directly linked from field vehicles to the Office of Materials Technology team for pavement monitoring
- Kick-started the investigation of roadway automation readiness and lead contributor to The Eastern Transportation Coalition AV readiness project
- Active stakeholder in national CAV initiatives, including the AASHTO National Strategy and USDOT Concept of Operations for roadway automation
- MDOT SHA in partnership with the Secretary's Office deployed a survey to local jurisdiction to identify their needs relating to emerging technologies [Link]
- Created a 60+ CAV solutions matrix with associated one-page summaries to support alternatives analysis development during the project planning stage
- Created an AASHTO TRAC CAV Module for national distribution to middle and high school students and piloted workshop with Maryland schools
- Released an updated ITS Communications Plan with CAV communications infrastructure needs included in long-term deployment
- CAV-related solutions for vulnerable users were recommended and approved for the 2021-2025 Maryland Strategic Highway Safety Plan
- Secured funding for a Maryland law review to identify the legal impacts of CAV on statutes and support future CAV legislation in Maryland
- 2019 STIC grant project for I2V deployment kicked off with vendor (Siemens) for vulnerable user safety at a crosswalk in Prince George's County
- Investigated the human impact of replacing existing MDOT SHA staff or contractual employees for three types of autonomous vehicle technologies
- Ongoing DSRC deployment at signals along US 1 (2017 SPaT challenge project)



Defining Connected and Automated Vehicles

Using accurate terminology is critical to effective communication. The use of "cars that drive themselves" works for mainstream conversations but does not encompass the span of what this technology can accomplish. For the purposes of this Plan, the term Connected and Automated Vehicles (CAV) better reflects the capabilities considered in the strategy development in this document.

This Plan uses the CAV definition as provided in the Maryland CAV Strategic Framework, shown word-for-word[3] below. For readers wishing to expand their understanding of CAV, please refer to the links in our Resources section.

Connected Vehicles (CV) "talk and listen" to infrastructure, other vehicles, and mobile devices. This communication enables applications that can warn a human driver of an impending hazard, enables a vehicle to operate more efficiently, or guides a vehicle to take appropriate action given the surroundings.

Automated Vehicles (AV) use sensors and other technologies to understand the environment to assist drivers and eventually perform driving tasks in place of a human driver. The Society of Automotive Engineers (SAE) has categorized various levels of automation often used by the industry when deploying these vehicles[4].

Connected and Automated Vehicles leverage connected capabilities with automated features to bring the best of both worlds into one vehicle.

The following brief infographic explains how the two could separately operate and how together they deliver a higher functioning mobility solution.

[3] Maryland CAV Strategic Framework [Link]
[4] SAE International levels of automation [Link]

Automated Vehicle Examples

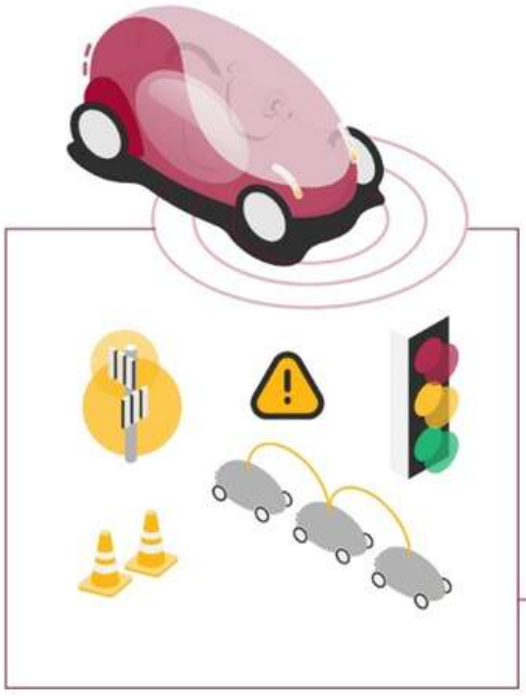
Personal Delivery Devices (PDDs)
Source: Austin, Texas Government PDD Pilot [Link]

Mobility as a Service (MaaS)
Source: Ars Technica, Waymo One [Link]

Truck Platooning
Source: Locomotive [Link]

Connected Vehicles

Connected vehicle technologies allow vehicles to communicate with each other and the world around them.



Current:

Navigation systems + Mobile applications
vehicle-to-infrastructure communication
Vehicle-to-vehicle communication
Vehicle-to-bike/ped/other Communication

Automated vehicles

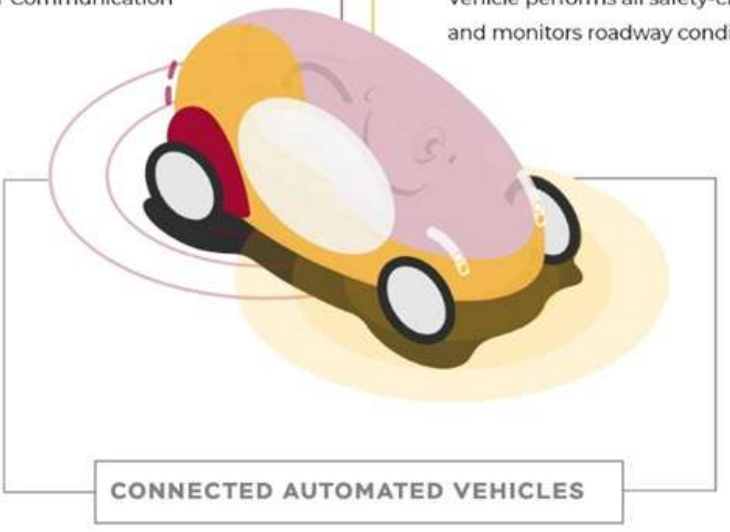
A fully autonomous vehicle does not require a human driver.

Current:

Self-parking & Collision, Avoidance Technology

Future:

Vehicle performs all safety-critical driving functions and monitors roadway conditions



CONNECTED AUTOMATED VEHICLES

Broader CAV Initiatives

National Efforts

The breadth of impacts CAV technology will have on the transportation ecosystem is so broad that the discussion often overflows across many stakeholder groups. MDOT SHA has been and continues to participate in several of these national dialogues. Recognizing that the successful deployment of CAV technology requires a closer partnership with private industry, MDOT SHA staff is actively networking to increase its awareness of CAV technology. Staff represents the agency and returns knowledge from national subject matter experts back to our local stakeholders for integration in Maryland. This includes sharing best practices or learning from neighboring states on how to support CAV technology or improve policies to protect the public's interest. Some of these national efforts include, but are not limited to:

Through the below collaborative venues, MDOT SHA became a lead contributor to the TETC automation readiness framework development and Roadway Automation Concept of Operations, reviewer of the CV PFS MAP Guidance document, and a panelist for one of the principal NCHRP CAV efforts (20-102), among other stakeholder efforts. MDOT SHA expects to continue to participate and contribute to these efforts and new ones as CAV technology discussions arise.

As webinars rose in popularity during 2020 due to social distancing and telework, staff began and continue to actively participate in informational CAV sessions to learn from various subject matter experts including through the Partners for Automated Vehicle Education (PAVE), the Institute of Transportation Engineers, the USDOT (e.g., Joint Program Office), the Transportation Research Board, and the Eno Center for Transportation.

NATIONAL EFFORTS

National Committee on Uniform Traffic Control Devices	**American Association of State Highway Transportation Officials, National Strategy on Transportation Automation**	**Cooperative Automated Transportation Coalition**	**Connected Vehicle Pooled Fund Study (CV PFS)**	**Automated Vehicle Pooled Fund Study**
The Eastern Transportation Coalition (TETC) Mid-Atlantic CAV Group & CAV Efforts	**US Department of Transportation (USDOT) Work Zone Data Exchange**	**USDOT Highway Automation Dialogues**	**USDOT CARMA Collaborative**	**USDOT Autonomous Vehicle Guidance (e.g. AV 4.0)**
USDOT FHWA Roadway Automation Concept of Operations	**The Intelligent Transportation Society of America, Advocacy Groups**	**Transportation Safety Advancement Group**	**National Cooperative Highway Research Program (NCHRP)**	

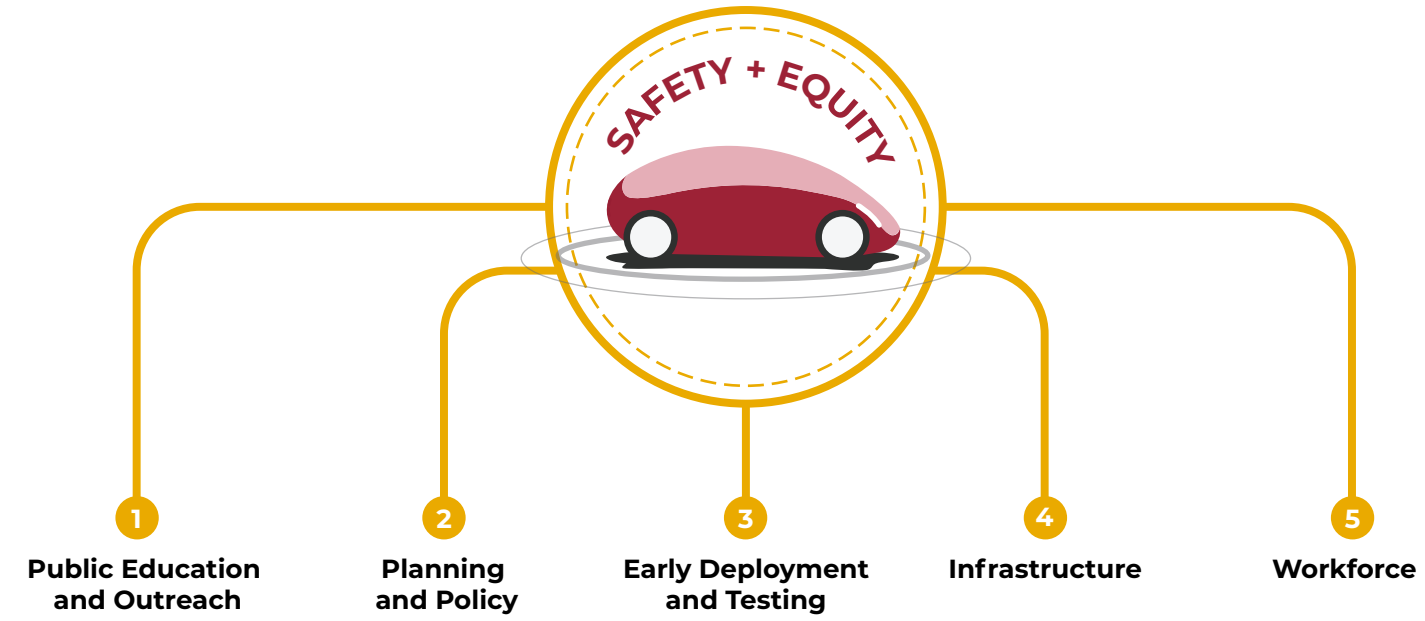
Maryland CAV Program

In 2015, Maryland took a bold and important step towards the integration of CAVs by creating the statewide Maryland CAV Working Group[5], led by MDOT's Motor Vehicle Administration (MVA) Administrator Christine Nizer and Maryland Transportation Authority (MDTA) Executive Director James F. Ports, Jr. In the years since, Maryland championed the creation of a statewide vision statement approved by Maryland's Governor, right, and increased coordination with external CAV partners.

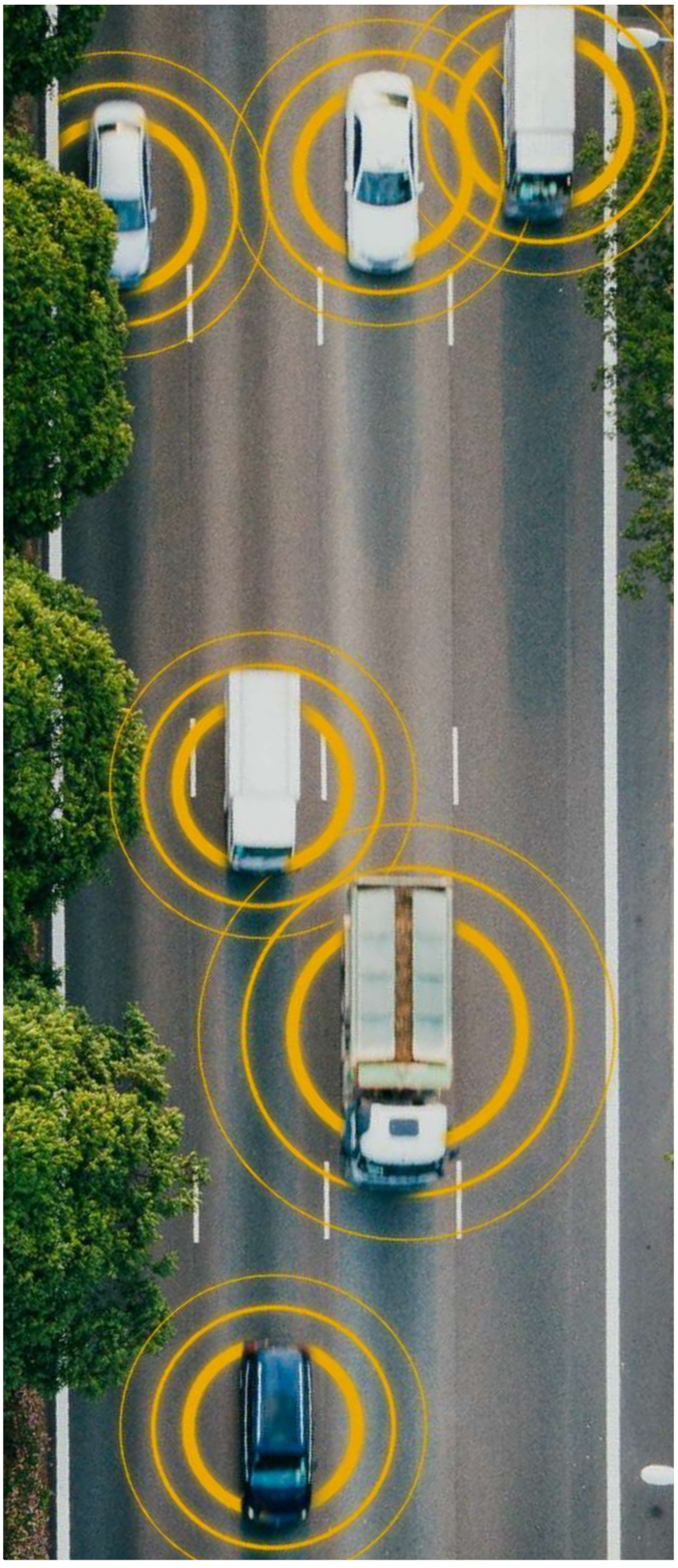
In 2020, the Maryland CAV Working Group spearheaded an effort to advance statewide engagement through developing a statewide **Maryland CAV Strategic Framework** (the Framework). Through diverse stakeholder input of more than 600 respondents and a 15-day public comment period, Maryland established five categories (illustrated in the graphic below) as critical to advancing CAV in the State.

> Maryland's Vision for Connected and Automated Vehicles (CAV) is to uphold and enhance a Safe, Efficient, and Equitable transportation future by delivering collaborative and leading-edge CAV solutions. Maryland is open for business and eager to realize the life-saving and economic benefits of CAV technology, while ensuring safety for all. We are embracing CAV technology and innovation through continuing collaboration with partners interested in researching, testing, and implementing CAVs in Maryland.

Souce: Maryland CAV Working Group



[5] Maryland Statewide CAV Working Group [Link]



High-level objectives within the Framework allow Maryland stakeholders to stake a claim in the realm of CAV technology implementation for their communities while providing a sense of direction for all of Maryland. It characterizes where Maryland stands today and offers a vision for where to go next, empowering State agencies, academia, and private industry.

The Framework's main goal is a call to action to all State and local agencies, private and academic partners, and the public to create implementation plans that align CAV technology strategies with this Framework for improved safety, efficiency, and equity throughout the State's transportation ecosystem.

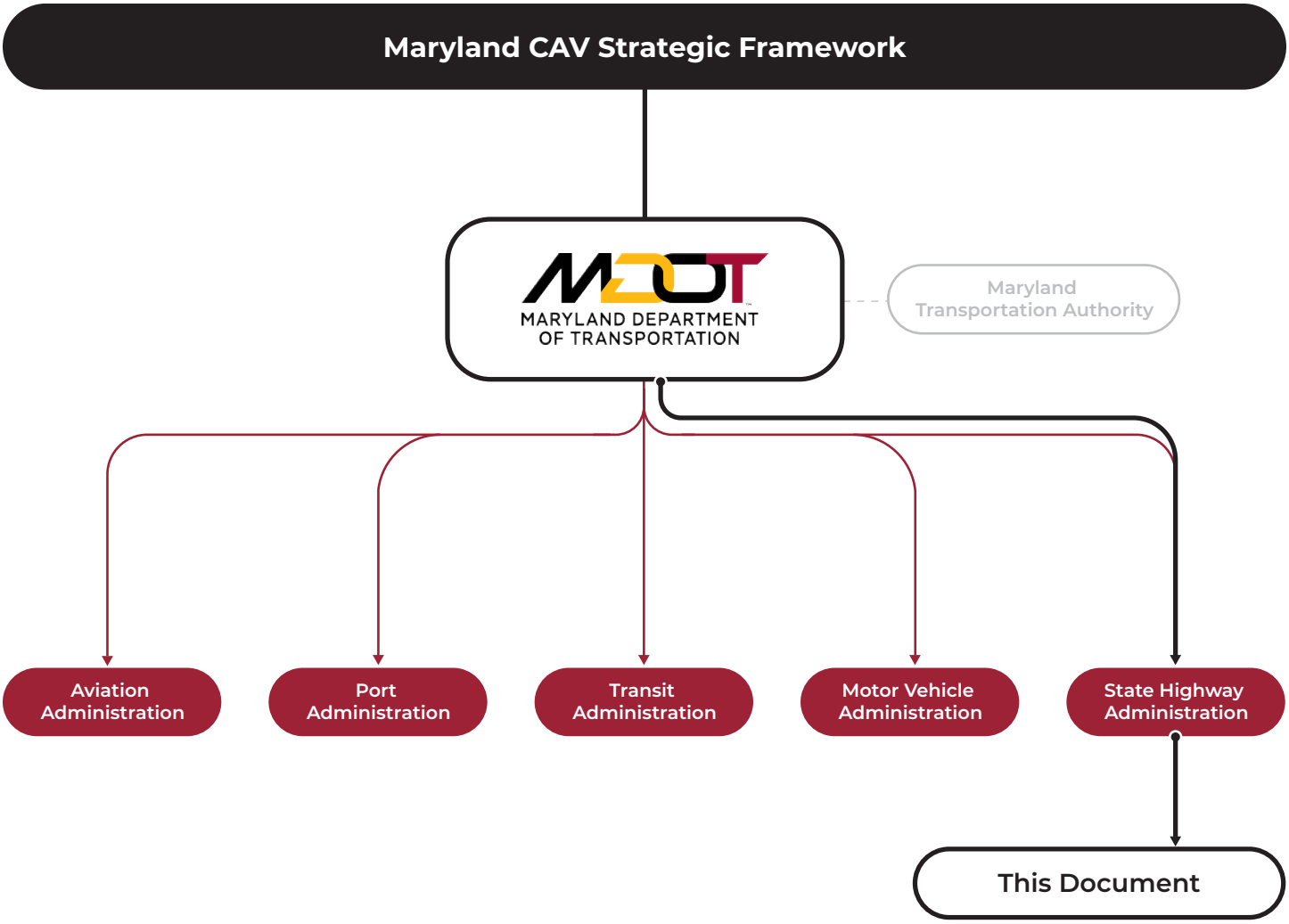
To better understand how MDOT SHA fits within that Framework and how we developed the implementation strategies outlined in this Plan, it is important to understand where MDOT SHA falls within the larger umbrella of statewide CAV efforts.

MDOT SHA belongs to the broader MDOT family, which is a multimodal agency responsible for roadway and bridge design, tolling infrastructure, motor vehicle safety, transit, vulnerable roadway users (e.g., bicycle and pedestrian), aviation, and ports. MDOT has at its core the following Mission statement:

> **MDOT MISSION STATEMENT**
>
> The Maryland Department of Transportation is a customer-driven leader that delivers safe, sustainable, intelligent, and exceptional transportation solutions in order to connect our customers to life's opportunities.

MDOT represents each mode of transportation through Transportation Business Units (TBUs), as illustrated in the graphic below. Each TBU has its own authority within Maryland's transportation ecosystem. **The Plan focuses solely on MDOT SHA's area of responsibility**, which encompasses non-tolled State arterials and highways. Any CAV recommendations within the authority of other MDOT TBUs are not referenced within the Plan.

For further details on what the other TBUs are pursuing in the realm of CAV, please refer to the Maryland CAV Working Group[6] and Maryland CAV Strategic Framework[7].



[6] Maryland CAV Working Group [Link]
[7] Maryland CAV Strategic Framework [Link]

Plan Objectives

National perspectives such as the one shown below, MDOT's mission, MDOT SHA's organizational values and principles, the Maryland CAV Strategic Framework, and MDOT SHA staff perspectives on agency readiness for CAV (collected via surveys) facilitated the creation of the Plan's objectives, which fall into the following key areas:

CORE MDOT VALUES

- **Safety**
- **Equity**
- **Economic Vitality**
- **Efficiency**
- **Agency Readiness**

The following pages detail the reasons for focusing on these five key areas, followed by the specific MDOT SHA objectives.

NATIONAL PERSPECTIVES

10-YEAR IMPACTS
2008-2017

$8 Trillion
ECONOMIC COSTS AND SOCIAL HARM OF CRASHES

32 Billion
GALLONS OF WASTED FUEL

346,626
TRAFFIC FATALITIES

78 Billion
TOTAL HOURS OF DELAY

$1.4 Trillion
ECONOMIC COST OF CONGESTION

OPPORTUNITIES FOR THE NEXT DECADE

- Enhance Economic Competitiveness
- Better Air Quality
- Enhanced Safety
- Improve Mobility
- Improve Supply Chain Efficiency

10-Year Estimated Impacts:
Sources: NHTSA,TTI

Safety | Core MDOT Values

The most frequently cited reasons for pursuing CAV are the safety benefits the technology could bring by reducing lives lost and injuries across our roadways. In 2019, the MDOT MVA Maryland Highway Safety Office (MHSO) [8] reported more than 115,000 vehicle crashes that resulted in 535 fatalities and more than 49,000 injuries. On average, in a single year, more than 26,000 people in Maryland sustain injuries from distracted driving related crashes. Nearly one in every four traffic-related deaths in Maryland is a vulnerable roadway user (VRU); aggressive driving plays a role in nearly 1 in 20 traffic injuries in Maryland, and in 7.4% of all traffic fatalities. The MDOT MVA MHSO continues to advocate ways to combat aggressive driving and reduce fatalities on our roadways, including the opportunities CAV technologies have to offer.

The Insurance Institute for Highway Safety (IIHS) reported[9] that seven of the existing advanced driver assistance technologies out on the market today resulted in a consistent reduction of crashes. The statistics reported below are related to injury crashes only but demonstrate the benefits this technology could have on reducing crash severities in Maryland, and nationwide.

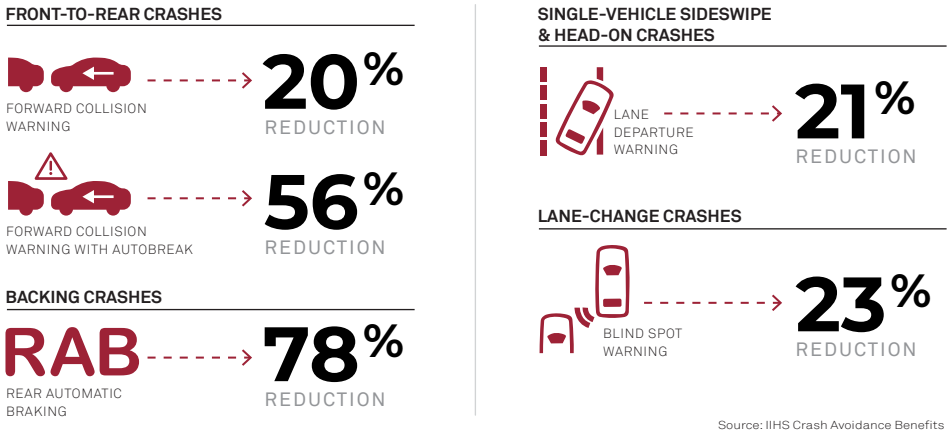
While vehicle manufacturers can provide safety benefits by implementing the above technologies, some safety strategies can—and should—be incorporated directly into the infrastructure. An example of infrastructure-based technologies includes transmitting warnings to approaching vehicles, autos and freight alike, in real-time of specific events the vehicles may not detect or "hear" about from nearby connected vehicles.

Though the below technologies could support safer roadways under existing travel patterns, we must also acknowledge the possibilities of creating new unsafe conditions. CAV technology is not always mature enough for many real-world situations and untested connectivity may increase the likelihood of cybersecurity breaches and terrorism – a concern frequently raised by the public. The MDOT SHA recognizes the potential for these risks and believes proactively engaging in these conversations keeps us informed and aware of CAV technology capabilities, rather than reacting to them post-event.

MDOT SHA PLAN OBJECTIVES FOR SAFETY

- Reduce fatalities (i.e. pursue Vision Zero)
- Reduce crash severities
- Reduce crashes at incident scenes, work zones, or during maintenance operations
- Expand and protect digital infrastructure

BENEFITS OF DRIVER ASSISTANCE TECHNOLOGIES IN REDUCING CRASHES IN MARYLAND



Source: IIHS Crash Avoidance Benefits

[8] MHSO Toward Zero Deaths [Link]
[9] IIHS Crash Avoidance Benefits [Link]

Equity | Core MDOT Values

As technology evolves, it becomes critically important that MDOT SHA safely integrates CAV technologies with an eye towards public visibility and public acceptance. It is also fundamental to ensure that deploying such technologies reaches all communities equitably. In some neighborhoods across Maryland, driving is the only feasible way to travel to work, access childcare, shop at quality markets, visit the doctor, take a vacation, or enjoy a night out. CAV solutions attempting to broach the equity barrier will have to learn from the public transit experience and find sustainable solutions that address the opportunities and challenges of rural, suburban, and urban needs in Maryland as a human-centric design rather than an afterthought or to meet a federal requirement for funding.

A CAV environment is also expected to allow those not previously included in traditional mobility solutions – the blind, differently-abled, young, and aging adults, to name a few – a level of freedom and independence not previously possible. The loss of driving ability, for example, often means a sharp decline in quality of life and is felt profoundly when one ages or experiences loss of motor functions. According to the Maryland Department of Aging, between 2015 and 2030, Maryland's 60+ population will increase from 1.2 million to 1.7 million, a 40% increase[10].

To tie those statistics to mobility challenges, a 2003 report found that almost six million people with disabilities had difficulties finding the transportation they need. More than 500,000 of those individuals were homebound because of transportation difficulties[11]. New modes of transportation under Mobility on Demand (MOD) or Mobility as a Service (MaaS) will open access to jobs, social activities, shopping, leisure, healthcare, and other opportunities for people with disabilities to improve their quality of life.

MDOT SHA PLAN OBJECTIVES FOR EQUITY

- Deploy of CAV solutions equitably
- Increase trips for mobility-constrained individuals

Source: Navya Autonom Shuttle [Link]

Source: Navya [Link]

[10] MD Dept of Aging, 2017 State Plan [Link]
[11] USDOT, Bureau of Transportation Statistics, "Transportation Difficulties Keep over Half a Million Disabled at Home," Issue Brief Number 3, April 2003 [Link]

Economic Vitality | Core MDOT Values

Maryland is open for business and cognizant of the economic opportunities the worldwide automated vehicle market has to offer. Financial estimates valued the 2019 CAV market at more than $25 billion, with an expected growth of more than 15% in the coming five years and predicted rise to $1 trillion by the end of 2030[12]. Within the United States, this economic opportunity has already been recognized:

- Arizona opened its state to CAV testing and attracted business, boosting the economy.
- California, as one of the strictest vehicle-permitting states in the nation, leads the charge in the number of active automated vehicle testing permits.
- Florida capitalized on the region's expertise in sensor technologies, due in part to NASA's presence, to create a broad CAV ecosystem.
- And many other states are leveraging their region's enthusiasm to deploy freight and localized CAV solutions.

In every state aggressively pursuing CAV, new jobs in cybersecurity and corollary innovations are transforming the current transportation workforce. Beyond jobs created, the proliferation of CAV technology and its supporting infrastructure offer other opportunities, such as expanded broadband access, telemedicine, education, and clean energy. Given the financial constraints that are ensuing from COVID-19, CAV initiatives that will drive businesses to Maryland to facilitate an economic rebound after, or even during, the COVID-19 pandemic are a priority.

Within the freight industry, CAV may produce significant benefits to the movement of goods and support economic stability. Since almost $300 billion worth of commodities traverse Maryland every year, one could expect that investment in this realm could support the State's economy.

MDOT SHA PLAN OBJECTIVES FOR ECONOMIC VITALITY

- Pursue CAV strategies that result in either net-zero job loss or an increase in jobs (i.e., expand workforce directly or indirectly related to CAV). Improve and increase access to jobs
- Attract business to Maryland and make Maryland an attractive partner for CAV development, testing, and production
- Pursue CAV strategies that support freight flow and goods movement

Source: Donald Roland Photography [Link]

[12] Fortune Business Insights & Mordor Intelligence

Efficiency | Core MDOT Values

Today MDOT SHA leverages vehicle probe data in planning, engineering, and real-time operations. In the future, advancements will occur in performance-based analysis for planning, real-time operations, safety, incident detection and response, travel-time reliability, traveler information and trip planning, asset-condition monitoring, and freight mobility – among many others. By leading the change in integrating vehicle data, versus reacting to the changes, MDOT SHA could be more versatile, both in real-time operations and long-term efficiency of the transportation ecosystem. This strategic approach ensures Maryland can harness the environmental efficiencies of CAV, including reduced energy consumption and emissions, achieved through operations (e.g., platooning, traffic smoothing, and expanded electrification). The impact CAV will have on land use and travel efficiency may not yet be clear; there is broad momentum to enact federal-level policies and programs to ensure net positive environmental impacts, with or without increased vehicle miles traveled.

Given existing budget reductions due to COVID-19, MDOT SHA has an opportunity to propose innovative solutions that shift from major infrastructure projects to projects blended with TSMO and CAV solutions that make more efficient use of existing facilities. An example of a preemptive action would be maximizing asset preservation through CAV asset condition monitoring and agency response. The use of innovative solutions would reduce the reliance on roadway expansion projects since technology-based projects in the TSMO and CAV realm offer more economic and potentially safer solutions. One could envision using CAV platooning solutions in congested conditions to significantly reduce rear-end and sideswipe crashes where aggressive or distracted driving causes unnecessary frustration and delays.

MDOT SHA PLAN OBJECTIVES FOR EFFICIENCY

- Maximize the capacity of existing facilities
- Maximize asset life

Agency Readiness

As an Infrastructure Owner Operator (IOO) and one of the largest land and roadways owners in Maryland, MDOT SHA is responsible for planning the adaptation of our roadways to accommodate current and future technologies. It is important that MDOT SHA sets guidance to adapt to dynamic changes in operating procedures and, at the very least, prepares our workforce to know where to find resources, and sets best practices on how to design, maintain, and operate in a CAV ecosystem. This means increasing our workforce's skill set and building the workforce of tomorrow.

MDOT SHA PLAN OBJECTIVES FOR AGENCY READINESS

- Maintain or increase national engagement
- Increase CAV awareness across MDOT SHA
- Gain experience through pilot projects
- Establish foundational systems or leverage existing business processes to support future CAV deployment
- Increase workforce development (internal and external)

SUMMARY OF PLAN OBJECTIVES

CORE MDOT VALUES

01. SAFETY

- Reduce fatalities (i.e. pursue Vision Zero)
- Reduce crash severities
- Reduce crashes at incident scenes, work zones, or during maintenance operations
- Protect digital infrastructure

02. EQUITY

- Equitable deployment of CAV solutions
- Increase trips for mobility-constrained communities

03. ECONOMIC VITALITY

- Pursue CAV strategies that result in either net-zero job loss or an increase in jobs
- Attract business to Maryland and make Maryland an attractive partner for CAV development, testing, and production
- Pursue CAV strategies that support freight flow and goods movement

04. EFFICIENCY

- Maximize the capacity of existing facilities
- Maximize asset life

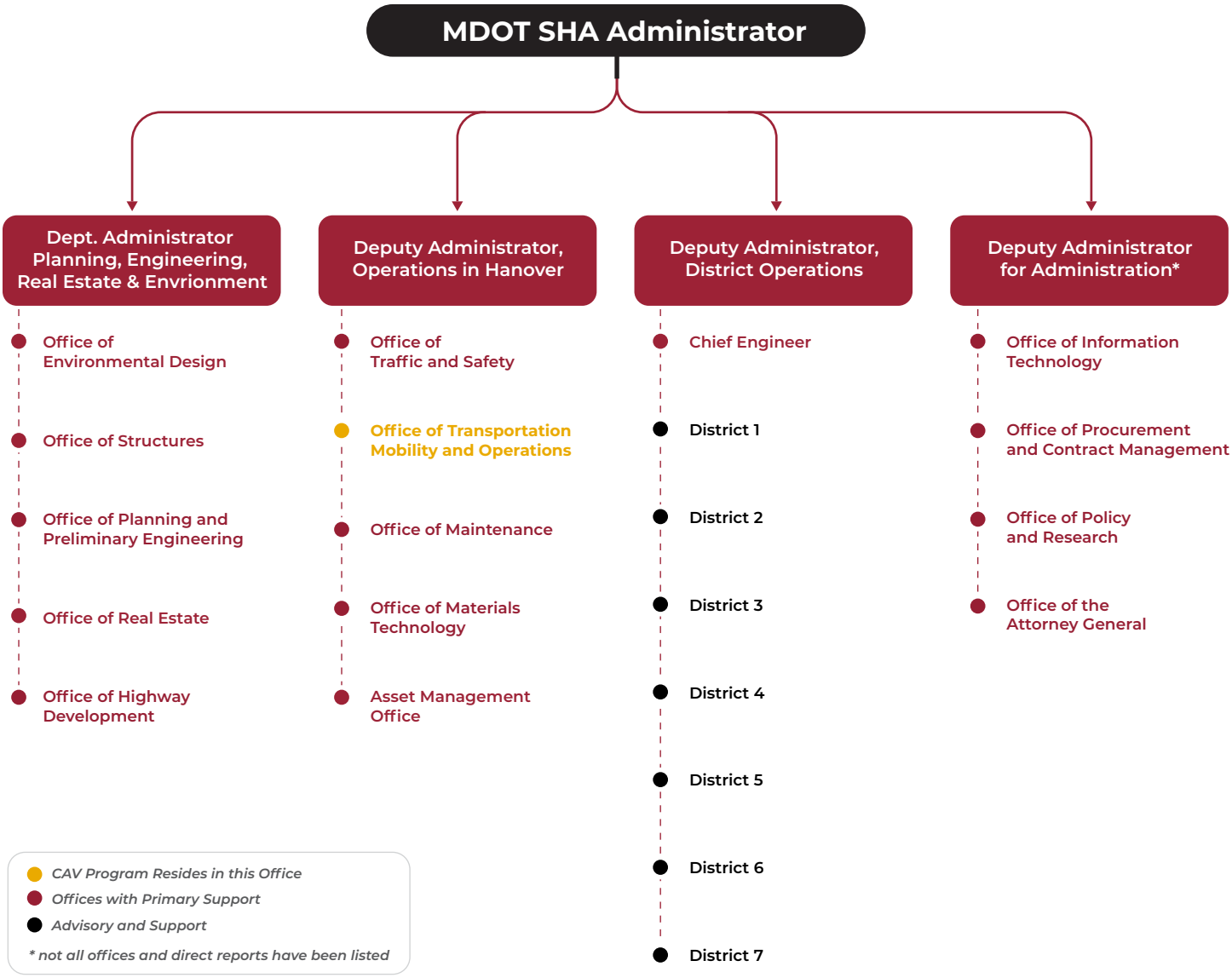
05. AGENCY READINESS

- Maintain or increase national engagement
- Increase CAV awareness across MDOT SHA
- Gain experience through pilot projects
- Establish foundational systems or leverage existing business processes to support future CAV deployment
- Increase workforce development (internal and external)

Plan Strategies

The following pages outline specific strategies MDOT SHA will undertake in 2021 – 2025 to meet the objectives set forth. These strategies may be supplemented annually as the years progress to account for milestones, new approaches, and changes in the CAV industry. All strategies also identify how they will meet the broader Maryland CAV Strategic Framework recommendations, and are further expanded upon, including the expected level of effort, timeframe, and responsible MDOT SHA office(s).

Thirty five strategies were identified, and for clarity, these were organized in seven themes, as shown on the following page. These themes are solely for flow of the narrative. **We also note that several of these strategies may share responsibility with MDOT, the broader Maryland CAV program, and other agencies.** For strategies that could impact others beyond MDOT SHA, we expect to collaborate, as appropriate, with the respective agencies. While we expect other agencies will be involved, the strategies shown here will still have MDOT SHA leadership within our area of responsibility.



STRATEGIES BY CATEGORY

PARTNERSHIPS & COLLABORATION

1 Sponsor/Host a series of public workshops and outreach events
2 Create template for public communication on CAV
3 Continue STEM/STEAM student CAV education
4 Leverage existing memorandums of understanding (MOUs) and partnerships
5 Pursue public-private partnerships
6 Continued participation and collaboration with Maryland partners external to MDOT SHA

WORKFORCE (MARYLAND CAV STRATEGIC FRAMEWORK KEY FOCUS AREA)

7 Continued participation and collaboration in national committees
8 Continue CAV education of MDOT SHA staff
9 Build a vision of MDOT SHA's workforce with CAV fully integrated into agency

POLICIES, LAWS, AND CONTRACTUAL MECHANISMS

10 Complete the Maryland law review
11 Consider policies, regulation, and possibly legislation that demonstrate we have privacy in mind
12 Develop or adopt cybersecurity protocols and procedures for connected vehicles
13 Create guidance/policy on use of V2X communications
14 Maintain CAV inclusion in RSAs
15 Improve contracting strategies for innovative technology deployments

FOUNDATIONAL PLANNING

16 Include CAV solutions in Highway Safety Improvement Plan (HSIP)
17 Redevelop the ITS Architecture to account for CAV
18 Evaluate and recommend freight-related CAV strategies
19 Improve internal planning methodologies to provide realistic CAV impacts
20 Evaluate synergies between electric vehicles (EV) and CAV
21 Continue to research CAV technology capabilities
22 Generate project concepts sufficiently developed for grant opportunities

ENGINEERING DESIGN

23 Develop technical specifications for connected vehicle devices
24 Signing and Pavement Marking Readiness for CAV

EARLY TESTING AND DEPLOYMENT (MARYLAND CAV STRATEGIC FRAMEWORK KEY FOCUS AREA)

25 Implement more CV, AV, and CAV pilots
26 Facilitate more effective CAV deployment by leveraging next generation ITS strategies and solutions
27 Pilot crowdsourced asset-monitoring system
28 Deploy TSMO System 1 Project with CV technologies
29 Deploy CAV solutions in Context Driven Zones
30 Support and deploy the goals of the 2021-2025 Strategic Highway Safety Plan
31 Statewide fiber P3 to deploy fiber communications
32 Deploy a fleet of, or functionalities of, CAV in existing MDOT SHA owned or contracted vehicles

SOFTWARE, CYBERSECURITY, AND ARTIFICIAL INTELLIGENCE

33 Create a connected vehicle data exchange portal
34 Upgrade the existing Advanced Traffic Management System to incorporate CV data
35 Develop a fleet management system

01 SPONSOR/HOST A SERIES OF PUBLIC WORKSHOPS AND OUTREACH EVENTS

Partnerships and Collaboration

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Public Education and Outreach

What

- Hold virtual public meetings in both corporate and community settings to increase public awareness of CAV. Expectations to work with Metropolitan Planning Organizations (MPOs), local jurisdictions, the Maryland legislature, and other partners. These efforts would likely also have a connection to the larger Maryland CAV Working Group.
- Provide a platform for the public to submit questions about CAV and receive feedback on MDOT SHA's CAV program.
- Submit an annual survey to local jurisdictions in coordination with The Secretary's Office to track CAV resources and knowledge. Possibly establish a metric to reach, such as achieving 80-90% CAV awareness across the State by 2025. This effort would be a continuation of the survey distributed in early 2020 [link].
- Revise the existing internal CAV 101 training module to be public facing (reframe and host online).
- This strategy will require MDOT approval to move forward, and notification / coordination with the broader Maryland CAV Program

GOAL(S) MET

5b

LEAD

OTMO with support from OPPE and the Office of Communications

WHEN

1-2 years, with recurring components

RESOURCES

Staff is limited and would depend on new funding, grant opportunities, or partnerships with external parties.

02 CREATE TEMPLATE FOR PUBLIC COMMUNICATION ON CAV

Partnerships and Collaboration

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Ensure all MDOT SHA offices, districts, and staff with public interactions have a standard operating procedure for CAV-related responses to the public. Also share with MPOs and local jurisdictions. A report published by the American Planning Association (APA) has proposed including CAV technologies in community visioning and goal setting, ensuring that the public and communities are involved in relevant planning activities to promote comprehension and acceptance and provide a mechanism for education and engagement. Ensure that this initiative's materials and language are consistent with the terminology as described earlier in this Plan. Language proposed may impact other CAV initiatives across the state, therefore language should be shared with MDOT leadership and coordinated with appropriate CAV stakeholders across Maryland and Nationwide.

GOAL(S) MET

5a-b

LEAD

Office of Communications, Districts, and OTMO

WHEN

6 months

RESOURCES

Current staffing and funding available.

03 CONTINUE STEM/STEAM STUDENT CAV EDUCATION

Partnerships and Collaboration

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Public Education and Outreach

What

Outreach to various levels of students through continued participation and encouraging CAV in Science Technology Engineering & Math/ Science Technology Engineering Art & Math (STEM/STEAM) events, such as through the Maryland Quality Initiative (MdQI), National STEM/STEAM week through local engineering chapters, local schools, and academia.

GOAL(S) MET

5e

LEAD

OTMO and MdQI outreach committee

WHEN

Annually

RESOURCES

Staff is limited and would depend on new funding or grant opportunities.

04 LEVERAGE EXISTING MEMORANDUMS OF UNDERSTANDING (MOUs) AND PARTNERSHIPS

Partnerships and Collaboration

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Public Education and Outreach

What

- Investigate existing MOUs and partnerships that could support CAV deployment. Determine types of deployments those partnerships could support and pursue as appropriate. These partnerships would improve MDOT SHA and stakeholder engagement in CAV, thus expanding the current knowledge of CAV across multiple organizations.
- Build and maintain a list of these partnerships and agreements, instituting a mutually agreed-upon mechanism for periodic update and refresh as technology and needs evolve.

A few example partnerships include:

- Notify truck drivers in-cabin of freight specific warnings (e.g., slick roads and tight curves) with the Maryland State Police (MSP), which currently works with Drivewyze.
- Create agreements with academia, which could spearhead leading-edge research in controlled environments.

GOAL(S) MET

5b and 5c

LEAD

OTMO primary investigator, with support from various MDOT SHA offices.

WHEN

Ongoing

RESOURCES

Staff is available, but would depend on new funding or grant opportunities.

05 PURSUE PUBLIC-PRIVATE PARTNERSHIPS

Partnerships and Collaboration

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Public Education and Outreach

What

Research public-private partnerships (P3s) and joint project-development options specific to Maryland laws, and document opportunities that may lead to a more efficient manner to integrate CAV throughout the State. P3 projects would have to follow specific Maryland State laws on thresholds, legislative approvals, etc. There are several projects, including those outlined in this Plan, that lend themselves well to P3.

GOAL(S) MET

2b, 3b (potentially others as well)

LEAD

OTMO, Office of P3, OPCM, others as appropriate.

WHEN

3-5 years

RESOURCES

Staff is available, but business processes are not well defined within the State for smaller scale P3s.

06

CONTINUED PARTICIPATION AND COLLABORATION WITH MARYLAND PARTNERS EXTERNAL TO MDOT SHA

Partnerships and Collaboration

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Public Education and Outreach

What

Encourage continued participation with Maryland-centric partners external to MDOT on CAV initiatives, to include the Maryland CAV Working Group, MPOs, local jurisdictions, MSP, Maryland Department of Planning, Maryland Department of Information Technology, private entities, and Maryland University systems. Includes projects such as building an automated freeway corridor using managed lanes, building transit-only lanes for autonomous shuttles, supporting port freight automation, facilitating trip optimization for airport influx and outflow, and coordinating with MDOT MVA on autonomous vehicle licensing and education.

The rapid evolution of CAV also will benefit from exploring collaboration with agencies and organizations traditionally not considered to be transportation focused, such as the Department of Commerce, Department of Labor, and Maryland Insurance Administration. Outreach should incorporate other public, private, or academic stakeholders that might be exploring how CAV impacts their initiatives.

GOAL(S) MET

5a

LEAD

Primary OTMO lead, with transition to broader MDOT SHA

WHEN

Ongoing

RESOURCES

Staff is available, but would depend on new funding or grant opportunities.

07 CONTINUED PARTICIPATION AND COLLABORATION IN NATIONAL COMMITTEES

Workforce

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Public Education and Outreach

What

Presence and engagement with national CAV activities across multiple coalitions and committees provide resources back to the agency on best practices and the latest information on technological advancement. Existing MDOT SHA engagement is shown below. Attendance should be maintained by MDOT SHA, but also expanded to broader offices within the agency. MDOT SHA should also consider attendance at other committees, pending staff availability. This includes encouraging diversification of staff participation in said coalitions, committees, and associations where Maryland can position itself to be an engaged partner nationally. Be prepared to adapt and change based on future federal guidance and standards (i.e., next Manual on Uniform Traffic Control Devices [MUTCD] edition, pavement marking standards for CAV vision).

GOAL(S) MET

5a

LEAD

Primary lead OTMO, with eventually transition across all MDOT SHA

WHEN

Ongoing

RESOURCES

Staff is available, but may be limited in specific offices or divisions.

AGENCY OR GROUP WITH THEIR SUBGROUP NAMES

CAT COALITION
- Policy, Legislative and Regulatory Planning Work Group
- Infrastructure/Industry Work Group
- Strategic Initiatives Work Group
- Technical Resources Work Group
- IOO/OEM Forum
- Peer Exchange and Outreach Work Group

WZDX
- Worker Presence
- V3 Specifications
- Technical Assistance Subgroup

CONNECTED VEHICLE PFS
- 3rd Party V2I
- Queue Warning
- MMITTS
- MAP Messages

AUTOMATED VEHICLE PFS
- *No Subgroups to Date*

ASSHTO
- CTSO – CAV group
- National Highway Automation Task Force

ITS AMERICA

NIST
- ADS Safety Measurement

NCHRP

THE EASTERN TRANSPORTATION COALITION
- Mid-Atlantic CAV Group

Note: Names and associations may change over time.

08 CONTINUE CAV EDUCATION OF MDOT SHA STAFF

Workforce

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Workforce

What

Internal education campaigns are crucial to gaining buy-in for CAV. This effort continues the development of training materials, lunch and learns, video-blog type informational material, briefings, etc., to educate staff on the progress of CAV nationally, within Maryland, and at MDOT SHA. Share training materials with other CAV stakeholders outside of MDOT SHA, including local jurisdictions and MPOs. This includes an annual survey of MDOT SHA staff to track awareness of CAV.

GOAL(S) MET

5e

LEAD

OTMO and Office of Administration

WHEN

Ongoing

RESOURCES

Staff is limited and would depend on new funding or grant opportunities.

09 BUILD A VISION OF MDOT SHA'S WORKFORCE WITH CAV FULLY INTEGRATED INTO AGENCY

Workforce

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Workforce

What

Build upon the initial workforce impact assessment to develop job classification language and create positions so that MDOT SHA employees can be an important part of the solution. Also, leverage the resources and templates in the 2019 NCHRP TSMO Workforce Guidebook [link], identify core gaps that exist in organizational knowledge, skills, and abilities (KSAs) today and in 5-10 years. Modify hiring criteria as needed to close these gaps.

GOAL(S) MET

5e

LEAD

OOA, with
OTMO support

WHEN

2-3 years

RESOURCES

Staff is limited and would depend on new funding or grant opportunities.

10 COMPLETE THE MARYLAND LAW REVIEW

Policies, Laws, and Contractual Mechanisms

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

State Planning and Research funds from the federal fiscal year 21 were awarded to complete a Maryland law review of the transportation code to evaluate possible ripple effects and gaps in law that would be impacted by CAV. Federal and state vehicle policy implications make it crucial for legislators, policymakers, and regulators to understand how the presence of automated vehicles will restructure the operation of roadway networks. Regulations regarding vehicle capabilities, testing and certification, insurance requirements, and more are important to consider when determining how to maximize the potential benefits of CAV and mitigate potential pitfalls.

GOAL(S) MET

5d

LEAD

OTMO, OAG, and OPR

WHEN

1 year

RESOURCES

Staff and funding available.

Follow-up action:
Ensure information is shared with legislative staff and partner with MDOT to develop appropriate legislative bills for CAV deployment in Maryland.

11 CONSIDER POLICIES, REGULATION, AND POSSIBLY LEGISLATION THAT DEMONSTRATE WE HAVE PRIVACY IN MIND

Policies, Laws, and Contractual Mechanisms

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Creation of MDOT SHA policies and/or regulations related to data privacy. These would ensure that MDOT SHA applies privacy-centric design prior to deployments. These could lead to larger legislation for the State, but should start within MDOT SHA.

As a starting point, USDOT has developed a method to protect privacy using a combination of map data and information theory. The result is context-specific strategies for hiding sensitive location and route information. This approach preserves precise location data characteristics necessary for effective safety and mobility applications, but mitigates the risk of the data unintentionally revealing any individual's travel patterns, protecting personal privacy. Moreover, it ensures that data quality remains high enough to support improved transportation operations and planning.

GOAL(S) MET

2a and 5d

LEAD

Administration, OPR, and OTMO + Original Equipment Manufacturers (OEMs)

WHEN

1-2 years

RESOURCES

Staffing available, funding limited.

12 DEVELOP OR ADOPT CYBERSECURITY PROTOCOLS AND PROCEDURES FOR CONNECTED VEHICLES

Policies, Laws, and Contractual Mechanisms

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Creation of cybersecurity protocols and standard operating procedures, including security credential management system in compliance with national standards for operational technology (OT) that would communicate with connected vehicles (one- and two-way communication). Current protocols would apply to DSRC and C-V2X operational technology. Consider implications of CAV in crime and national security. Investigate solutions such as trip logging (similar to trip registry to fly a private plane) and how they tie into other strategies outlined in this Plan.

As a starting point, USDOT has issued a best practice guide for cybersecurity and intelligent transportation systems and will require decisions on several topics when conducting effective Penetration Testing (PT) of managed intelligent transportation systems. The guide acknowledges that an ITS consists of information and communication technologies applied to transport infrastructure, such as road networks and traffic and transit systems, with objectives to, in part, support connected vehicle initiatives to increase communications and take advantage of new applications using increasing computing in vehicles. The guide also asserts that DOTs must put in place cybersecurity management programs to address potential risks with increasingly connected and automated transportation systems using ITS and supporting technology.

As an additional component of security, and to foster trust in CAV applications, security credential management systems should be incorporated across the board into future deployments. Protocols are also likely to be coordinated with Maryland's Department of Information Technology, among others that have broader statewide responsibility for protection of data exchanges.

GOAL(S) MET

1d, 3b, 4a-b, and 5d

LEAD

OIT, Office of Homeland Security, and OTMO

WHEN

1 year

RESOURCES

Skill sets need to align and funding limited.

13 CREATE GUIDANCE/POLICY ON USE OF V2X COMMUNICATIONS

Policies, Laws, and Contractual Mechanisms

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Establish general policy and operational guidance for wireless, broadband, and OEMs to understand V2X communications strategies for MDOT SHA facilities. Research connectivity options and solutions, leveraging next generation networks (e.g., 5.9Ghz spectrum or 5G) to reduce latency and provide fast, reliable, secure connectivity for CAV.

In addition to Maryland's leadership in this area, close attention should be paid to the still-evolving Federal Communications Commission's (FCC) rulemaking process in this area (e.g. FCC Docket 19-138). On November 18, 2020, the FCC approved an order report for "transitioning all ITS operations in the revised ITS band to 5.850-5.925 GHz, and eventually converting to C-V2X-based technology." Awareness of these proceedings will help to enhance and future-proof Maryland's guidance creation process, and engagement in the open comment periods during the proceedings will continue to position Maryland at the forefront of establishing nationwide policy for V2X communications.

GOAL(S) MET

3b, 4a-b, and 5d

LEAD

OTMO

WHEN

1 year

RESOURCES

Current staffing and funding available.

14 MAINTAIN CAV INCLUSION IN RSAs

Policies, Laws, and Contractual Mechanisms

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Early Testing and Deployment

What

Ensure that Resource Sharing Agreements (RSAs) continue to incorporate CAV communication needs. CAV, particularly CV applications, bring new requirements for low latency and backhaul capacity. While the solutions are rapidly evolving, whether transmission is via DSRC or C-V2X, fiber backbone infrastructure for MDOT SHA operations use will still be required to leverage the benefits of CV applications across widespread areas. In addition to fiber needs, as companies seek RSA access to MDOT SHA right-of-way for small cell 5G deployment, look for opportunities to co-locate ITS/CAV devices and leverage power/utility runs for those deployments. This recommendation for RSAs is also outlined in the ITS Communications Plan.

GOAL(S) MET

1d, 2a, 3b, 4a, and 5d

LEAD

OOC and OTMO

WHEN

Ongoing

RESOURCES

Current staffing is available and funding is dependent on third-party agreement.

15 IMPROVE CONTRACTING STRATEGIES FOR INNOVATIVE TECHNOLOGY DEPLOYMENTS

Policies, Laws, and Contractual Mechanisms

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

Procurement timelines, while ensuring compliance, are difficult to navigate quickly and nimbly. This effort will lead and champion changes or policy recommendations to accelerate the procurement of innovative solutions, including joint-development strategies. This effort also champions possible improvements to Qualified Products List (QPL), requesting that CAV be a category for the National Association of State Procurement Officials purchasing agreement, as well as ways to incorporate vendors in grant applications to meet federal guidelines, among others. Partnerships with manufacturers will help MDOT SHA stay ahead of what is being introduced in the marketplace. An immediate action item may be to add CAV infrastructure requirements to the I-270 – I-495 Managed Lanes project.

GOAL(S) MET

2a, 3b, and 5d

LEAD

OPCM, with OTMO support

WHEN

2-3 years

RESOURCES

Staff is limited and would depend on new funding or grant opportunities.

16 INCLUDE CAV SOLUTIONS IN HIGHWAY SAFETY IMPROVEMENT PLAN (HSIP)

Foundational Planning

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

The federal authorization for transportation, Fixing America's Surface Transportation Act (FAST Act), has identified connected vehicle programs as HSIP eligible - specifically, the installation of vehicle-to-infrastructure communication equipment. Maryland will incorporate CAV solutions into its annual HSIP assessment and identify tangible funding solutions for CAV strategies. Possible qualifying HSIP CAV projects include:

a. Location with a higher-than-expected number of crashes (LOSS 3 or LOSS 4)
b. Location with an identified crash pattern (through direct diagnostics or crash pattern analysis) that can be mitigated by the proposed strategy
c. Location with a high crash potential

GOAL(S) MET

1a-c

LEAD

OOTS, with support from MDOT SHA CAV Working Group

WHEN

Annually

RESOURCES

Available

17 REDEVELOP THE ITS ARCHITECTURE TO ACCOUNT FOR CAV

Foundational Planning

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Update the Maryland Statewide ITS Architecture to account for CAV solutions based on the latest USDOT standards and the Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) that has absorbed the older Connected Vehicle Reference Implementation Architecture (CVRIA). USDOT requires that states and regions deploying ITS projects funded from the Highway Trust Fund develop a statewide/regional ITS architecture based on the National ITS Architecture. Generally speaking, CAVs are expected to impact statewide ITS architectures by enhancing current ITS services in the short term and replacing ITS services/providing new services in the long term; strengthening the linkage between the operations and planning of ITS by involving a wider array of stakeholders in activities such as creating and sharing new data sources; and introducing new priorities in ITS operations and planning. For example, if the potential of CAVs to significantly reduce crashes is realized, it would allow a state department of transportation to reallocate some resources currently dedicated to safety and incident management. This initiative will require coordination with several other stakeholders, including for example the Maryland Transportation Authority.

GOAL(S) MET

5d and 5e

LEAD

OTMO

WHEN

1-2 years

RESOURCES

Limited staff time and would depend on new funding or grant opportunities.

18 EVALUATE AND RECOMMEND FREIGHT-RELATED CAV STRATEGIES

Foundational Planning

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Pursue analysis and deployment of freight-related CAV strategies, especially as they relate to the 2020 Maryland Statewide Truck Parking Study and the State Freight Plan update, due in 2021, including but not limited to:

a. Developing a statewide freight-technology ecosystem to support national movement of goods, which could tie into the "Autonomous Freight Network," and other national efforts.
b. Evaluating and recommending freight CAV solutions within well-defined freight circuits where short hauls could benefit from AV type solutions while balancing possible job loss to drivers.
c. Identifying high-frequency first and last mile locations where delivery services (e.g. Amazon, UPS, FedEx, etc.) might find autonomous package delivery to be the most beneficial. This will also incorporate exploring vehicles that traverse on the ground (personal delivery devices) as well as in the air (unmanned aerial vehicles).
d. Establishing Freight Traveler Information Systems to push CV data to the truck driving community in the format (in cab) that is most convenient for them.
e. Developing a truck parking information system, perhaps using connected freight data made available in real-time, to inform truck drivers of utilization levels at Maryland parking locations.

GOAL(S) MET

3a, 3b, 5c, 5d, and 5e

LEAD

OPPE, with OTMO support

WHEN

1-2 years

RESOURCES

Limited staff time and would depend on new funding or grant opportunities.

These initiatives will require coordination with other stakeholders, for example MDOT and the Statewide Freight Advisory Committee.

USDOT is required to establish a national freight plan and national freight performance measures. States are subsequently encouraged to develop statewide freight plans, and projects identified in these plans are eligible for specific new freight funding. States are also required to set performance targets in relation to the national freight performance measures, which can be incorporated into the statewide freight plan and/or the State long-range transportation plan (LRTP). CAV technology offers significant potential benefits to the freight industry, including increased efficiency, reduced emissions, improved safety, and economic benefits. Given this, the freight industry is expected to be an early adopter of CAV, making it particularly important to begin incorporating CAV technology into freight plans.

Other states and regions are pursuing similar efforts; exploring/documenting their efforts as an input to Maryland's initiatives will be instructive.

19 IMPROVE INTERNAL PLANNING METHODOLOGIES TO PROVIDE REALISTIC CAV IMPACTS

Foundational Planning

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

A significant amount of work still needs to be completed within the CAV planning realm, to include but not be limited to:

a. Developing ways to perform CAV scenario planning (Lead: OPPE - TFAD).
   i. Will require developing standard operating procedures on how to perform scenario planning with Maryland-specific data, likely to require reviews of existing practices and then implementing for MDOT SHA.
   ii. Will require performing a limitation (or pro-con) evaluation of available MDOT SHA software capabilities to model CAV (e.g., Maryland Statement Transportation Model).

b. Deploying a scenario-based survey to better understand how people wish to move in an automated vehicle world (Lead: OPPE - TFAD).
   i. This was originally a TSO effort that was eliminated due to financial constraints; however, this is still an important task to move forward.
   ii. A scenario-based survey would better reflect trips compared to existing regional demand models.

c. Analyzing land use trip impact through CAV (Lead: OPPE - TFAD).
   i. Developing a report for reference of which CAV mobility solutions have high impacts on mobility and optimal land use diversification.
   ii. Working with the Maryland Department of Planning to understand resilient land use during times of stress, such as pandemic-like conditions through CAV solutions.

d. Providing CAV recommendations to local jurisdictions on long-term planning documents (Lead: OPPE – TFAD and RIPD).

e. Incorporating CAV solutions in preliminary planning, tying to the recently released CAV solutions matrix and above CAV land use analysis (Lead: OPPE - TFAD and PMD).

f. Creating a performance metric to track the impact of CAVs (Lead: OPPE - IPPD) that can be reported in the Mobility Report and Accelerator Program (or other MDOT-wide programs).

g. Continue developing data governance guidance documents, especially as it relates to connected vehicle information (Lead: OPPE - DSD).

GOAL(S) MET

5b and 5d

LEAD

OPPE

WHEN

2 years

RESOURCES

Some staffing availability and some internal funding available.

20 EVALUATE SYNERGIES BETWEEN ELECTRIC VEHICLES (EV) AND CAV

Foundational Planning

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Evaluate vehicle charging demands and our current charging infrastructure in relationship with CAV needs (both private and government-owned) to determine a statewide network for improving infrastructure to encourage more electric vehicle use, understanding that CAV and electric vehicles are not the same, but are often linked. Would involve collaboration with statewide EV plans currently coordinated by MDOT.

As Maryland embarks upon CAV-focused pilot demonstrations and new mobility solutions, MDOT SHA can collaborate with other key partners and stakeholders to incorporate strategies that capitalize on vehicle electrification or clean energy. The inclusion of "smart mobility hubs" that might encourage first/last mile autonomous and shared vehicles for people or package delivery are examples of broader strategic thinking that incorporates this philosophy.

GOAL(S) MET

4a, 5a, and 5e

LEAD

OPPE and OTMO

WHEN

2 years

RESOURCES

Limited staffing availability, funding available through TSO.

21 CONTINUE TO RESEARCH CAV TECHNOLOGY CAPABILITIES

Foundational Planning

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Submit CAV research project statements to OPR's annual call for projects related to CAV innovation. OPR functions as a liaison on federal and State legislative issues and manages MDOT SHA's research programs. OPR ensures that provisions and requirements in the federal highways program are understood and fully utilized for Maryland's benefit, reviews proposed State legislation, and coordinates legislative strategies. OPR also manages annual research work programs, coordinates participation in the Transportation Research Board (TRB) and NCHRP, and works closely with university partners.

GOAL(S) MET

All

LEAD

MDOT SHA internal CAV working group

WHEN

Annually (end of winter/ early spring)

RESOURCES

Staffing and funding available.

22 GENERATE PROJECT CONCEPTS SUFFICIENTLY DEVELOPED FOR GRANT OPPORTUNITIES

Foundational Planning

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

The current FAST Act includes several grant programs that may be of interest to MDOT SHA in advancing CAV initiatives. MDOT SHA should have a program in place that will have projects and ideas "on the shelf" with concepts fleshed out, instead of waiting for a grant opportunity to be published. Most of the grant applications provide a 30- to 60-day window for submittal, but the project conceptualization process can often take 90 to 120 days or even longer when coordinating partners and approvals.

Clarify with the MDOT SHA Office of Procurement and Contract Management the potential role of consultants in developing grant applications or project concepts for grant applications. Given the resource constraints that exist within MDOT SHA, it will be difficult to maintain this on-the-shelf capability without engaging consultants, but current conversations are unclear in terms of eligibility and potential conflict in terms of using consultants.

GOAL(S) MET

3b, 5c, and 5d

LEAD

OTMO

WHEN

1-2 years

RESOURCES

Staff is available, but business processes are not well defined internally.

23 DEVELOP TECHNICAL SPECIFICATIONS FOR CONNECTED VEHICLE DEVICES

Engineering Design

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Infrastructure requirements and guidelines are a key component to successfully deploying CAV technology and ensuring interoperability throughout the State and region at large. This can include traffic signal hardware, connected vehicle roadside equipment (i.e. DSRC or CV2X radios), and other connected vehicle support infrastructure (in-cabinet processors, LiDAR sensors, etc.).

A set of guidelines should be developed in concert with local agencies that can be applied at signalized intersections across the State to allow for ease of CAV deployment and interoperability. This might include an emphasis on greater standardization of traffic signal cabinets, controller types, communications, switches, power, grounding, etc.

The guidelines should also establish mounting recommendations for the CV roadside equipment to maximize transmission distances and reduce interference. Guidance on doing field surveys, installation and network considerations, and roadside unit configuration should be incorporated where feasible. For locations where CV deployment will not be accompanied by full replacement of the existing hardware/equipment, space and power requirements for signal control cabinets and other infrastructure should be developed to support CAV technologies.

A field inventory should be completed to determine which traffic signals require full replacement of the existing hardware/equipment to meet the recommended guidelines and which locations only require only upgrades. A checklist should be developed to document the inventories and prioritize upgrades.

GOAL(S) MET

3b, 4a-b, and 5d

LEAD

OTMO and OOTS

WHEN

1-2 years

RESOURCES

Current staffing/skill and funding is limited, though some efforts may be eligible for HSIP funding.

24 SIGNING AND PAVEMENT MARKING READINESS FOR CAV

Engineering Design

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

Explore and put a process in place to achieve minimum acceptable CAV signing and pavement marking guidelines, in compliance with current and new standards set by the USDOT Federal Highway Administration (FHWA) and the Manual on Uniform Traffic Control Devices (MUTCD). Coordination with local agencies, developing recommended maintenance standards and schedules should be considered, along with service life guidelines. Perform a review of new and evolving national infrastructure guidelines related to CAV to determine if they are sufficient for everyday needs as well as for special cases (such as inclement weather, especially for evacuation route applications).

Participate in national research currently evaluating if the current design and maintenance of pavement markings and signage are compatible with the needs of CAV. This should include recommendations from CAV technology manufacturers and consideration of regional and national practices to allow for interoperability.

GOAL(S) MET

1a, 1b, 1c, and 5d

LEAD

OOTS, OOM, and OTMO

WHEN

1-2 years

RESOURCES

Limited staff time and would depend on new funding or grant opportunities.

25 IMPLEMENT MORE CV, AV, AND CAV PILOTS

Early Testing and Deployment

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Early Deployment and Testing

What

Pilot efforts play a central role in proofs of concepts, public education, and agency capacity building. This item can take any of several forms: testing a targeted geographic area, performing monitoring and data collection, and receiving daily updates from the pilots are some examples. These pilots often entail identifying and executing short-term projects that can move the ball forward on real-world deployment, thereby bringing CAV benefits to road users sooner. This effort will consider State or local pilots and possibly use existing highway lanes for CAV to test speed control on CAV dedicated lanes to demonstrate their capabilities.

While some pilot concepts will come to MDOT SHA from private partners seeking to solve specific needs, the agency can better prepare itself in advanced for future pilots through several readiness steps including (but not limited to):

- Identifying corridors or locations that would benefit from specific applications
- Encouraging interoperable infrastructure elements between the State and local agencies (e.g., making sure that connected vehicle roadside units are interoperable across jurisdictional boundaries)
- Identifying public-feedback opportunities with existing and new pilot projects
- Working with existing and new pilot projects to better document future workforce impacts
- Maintaining awareness of federal grant and other external funding opportunities for pilots and projects

GOAL(S) MET

All

LEAD

OTMO primary with coordination through others within MDOT SHA and stakeholders

WHEN

Unknown (see below)

RESOURCES

Current staffing is available; however, funding is non-existent. Recommendation to pursue grant opportunities.

26 FACILITATE MORE EFFECTIVE CAV DEPLOYMENT BY LEVERAGING NEXT GENERATION ITS STRATEGIES AND SOLUTIONS

Early Testing and Deployment

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

Improving smarter ITS brings CV technologies benefits to road users sooner and improves the transportation ecosystem overall. Many CV applications are accelerated by smarter ITS: traffic signal phase and timing (SPaT) messages, pedestrian safety applications, vehicular navigation systems coordinated with system data to and from MDOT SHA systems, and improved situational awareness via Advanced Traffic Management System are just a handful of example applications. Plan and prioritize the installation of CAV sensors and equipment so that areas with high traffic volume and high collision rates have equipment in place as early as possible, among other "smart" solutions. Related broad applications include "smart cities" solutions. Include CAV readiness assessments that determine how "ready" existing ITS and CAV infrastructure (both digital and physical) is to accept varying levels of CAVs and suggesting improvements.

GOAL(S) MET

1a-d, 4a-b, and 5c-e

LEAD

Primary OTMO, with broader involvement from all MDOT SHA

WHEN

Unknown (see below)

RESOURCES

Current staffing is available; however, funding is non-existent. Recommendation to pursue grant opportunities.

27 PILOT CROWDSOURCED ASSET-MONITORING SYSTEM

Early Testing and Deployment

What

Pilot a novel crowdsourced asset-monitoring system such as Payver, Nexar, Mobileye, or others that can track infrastructure asset conditions across all facilities on a regular basis (e.g., daily). Minimum assets to be monitored include pavement markings, guardrail, attenuators, barriers, traffic-control devices (e.g., signs and signals), and pavement surface conditions.

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Early Deployment and Testing

GOAL(S) MET

4a and 5c-d

LEAD

OOM, OMT, and OTMO

WHEN

1 year

RESOURCES

Current staffing is available, but funding is limited. Possibility of partnership with other State or federal entities.

28 DEPLOY TSMO SYSTEM 1 PROJECT WITH CV TECHNOLOGIES

Early Testing and Deployment

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

Deploy queue warning, variable speed limit, in-vehicle notification feeds, and other CV capabilities and applications in the TSMO System 1 project. Even as these safety notifications may continue to be delivered via conventional means (e.g., visual alerts to drivers), they are critically important in the evolution of CV applications. As technologies develop, the alerts will be exchanged via automated, low-latency transmission with CV-equipped vehicles, including for the mixed fleets still before us. CAV solutions should also be incorporated in TSMO projects identified in the TSMO Master Plan, as well as future projects.

GOAL(S) MET

1a-d, 4a-b, and 5b-d

LEAD

OTMO; coordinate with local jurisdictions in the corridor

WHEN

3-4 years

RESOURCES

Current staffing is available, but funding is on hold.

29 DEPLOY CAV SOLUTIONS IN CONTEXT DRIVEN ZONES

Early Testing and Deployment

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

Community mobility and access for all users can especially benefit from many CAV solutions. One tactic this item entails is the installation of pedestrian sensors in Context Zones A, B, and like corridors in Context Zone C. The focus and goals of each corridor would be driven by the attributes and qualities of the individual Context Zone. Multiple implementation strategies can be assessed for how well they meet the corridor goals.

GOAL(S) MET

1a-b, 2a-b, and 5c-d

LEAD

All MDOT SHA

WHEN

1-5 years

RESOURCES

Current staffing is available, but funding is non-existent.

30 SUPPORT AND DEPLOY THE GOALS OF THE 2021-2025 STRATEGIC HIGHWAY SAFETY PLAN

Early Testing and Deployment

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

The Strategic Highway Safety Plan (SHSP) is a foundational and federally required planning document. Enacted in Maryland in 2019, Vision Zero establishes a goal of zero fatalities or serious injuries on Maryland's roadways by 2030, and the promising safety benefits of CAV deployment can play a prominent role in that effort. Specifically, Maryland's 2021-2025 SHSP includes researching, educating, and deploying CAV solutions for VRU safety. This strategy includes assigning resources to do the researching, educating, and deploying. The SHSP also encourages the use of CAV across all emphasis areas to improve safety.

GOAL(S) MET

1a-c and 2a

LEAD

OTMO and OOTS

WHEN

1-5 years

RESOURCES

Current staffing is available, and funding may be available through HSIP.

31 STATEWIDE FIBER P3 TO DEPLOY FIBER COMMUNICATIONS

Early Testing and Deployment

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

Building on the previous RSA item, explore the feasibility and potential benefits delivered by a statewide fiber P3 or RSA to deploy fiber communications throughout Maryland to support MDOT needs and future CAV technologies. MDOT SHA access to widespread fiber backbone for low-latency applications and sufficient backhaul will enable the acceleration and proliferation of CAV benefits statewide.

GOAL(S) MET

1d, 3a-b, 4a-b, and 5d

LEAD

OOC and OTMO

WHEN

3 years

RESOURCES

Current staffing is limited, and funding is dependent on third-party agreement.

32 DEPLOY A FLEET OF, OR FUNCTIONALITIES OF, CAV IN EXISTING MDOT SHA OWNED OR CONTRACTED VEHICLES

Early Testing and Deployment

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Early Deployment and Testing

What

This effort depends on Strategy 35, for a better understanding of cost to deploy. There are multiple benefits to piloting new CAV technology among agency fleet vehicles, including control, oversite, risk mitigation, low cost, and capacity building. Agency fleet vehicle integration is one of eight integration cases identified in USDOT FHWA's Concept of Operations.

Deploy CAV capabilities in operations, beginning with automated truck mounted attenuators in maintenance activities (to be determined by OOM), automated parking such as STEER on OTMO light-duty and patrol vehicles, and testing of automated snowplows.

GOAL(S) MET

4a and 5b-e

LEAD

OOM and OTMO

WHEN

2-3 years

RESOURCES

Current staffing and vehicle fleets are available, but funding is limited.

33 CREATE A CONNECTED VEHICLE DATA EXCHANGE PORTAL

Software, Cybersecurity, and Artificial Intelligence

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

Creation of a connected vehicle data exchange portal that allows two-way data exchange between on-board CAV systems and MDOT SHA. This would follow previous strategies to align with internal cybersecurity and privacy guidance. This effort should leverage lessons from USDOT's CARMA initiative and other efforts already underway in this realm. Consider the creation of arterial and intersection safety applications with the available data, such as eco-driving, freight or transit preemption, emergency vehicle response, and many others available.

GOAL(S) MET

1d, 2a, 4a, and 5d

LEAD

OTMO and OIT

WHEN

1-2 years

RESOURCES

Staff and funding not currently available.

34 UPGRADE THE EXISTING ADVANCED TRAFFIC MANAGEMENT SYSTEM TO INCORPORATE CV DATA

Software, Cybersecurity, and Artificial Intelligence

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Infrastructure

What

As connected vehicle (CV) data to and from MDOT SHA become more streamlined, establish a policy to create modules and systems within the OTMO Advanced Traffic Management System (ATMS) to support situational awareness and roadway operations' efficiency. This not only applies to longer-term implementation of new applications, but should incorporate shorter-term considerations for demonstrations or early deployments that are not feasible for immediate incorporation and therefore must operate in parallel. Determine if there are methods for enhancing side-by-side operation so that data sets can be leveraged and physical operations are not compromised.

Maryland's ITS Architecture is an important resource with this strategy, as is the current Architecture Reference for Cooperative and Intelligent Transportation (ARC-IT) that has subsumed early connected vehicle architecture concepts for exactly the purposes that this effort entails. Staff leading this should be familiar with USDOT's efforts with the Connected Vehicle Pilot Deployment Program, CARMA platform, OpenDrive, and current and emerging data standards for data exchange, cybersecurity, and privacy. Numerous CV applications exist, even if some remain in infancy, that will mutually benefit both MDOT SHA and all road users. The ongoing migration away from DSRC should not dissuade, as benefits of CV applications are just as promising with C-V2X.

GOAL(S) MET

1d, 2a, 4a, and 5d

LEAD

OTMO

WHEN

2-3 years

RESOURCES

Staff is available, but funding is unavailable.

35 DEVELOP A FLEET MANAGEMENT SYSTEM

Software, Cybersecurity, and Artificial Intelligence

MARYLAND CAV STRATEGIC FRAMEWORK CATEGORY

Planning and Policy

What

Creation of a vehicle fleet-management system that considers ITS and CAV devices mounted to agency vehicles. This system will serve to determine which vehicles are capable of performing CAV functions and to make asset and configuration management more efficient. In its most recent autonomous vehicle guidance, Ensuring American Leadership in Automated Vehicle Technologies v. 4.0, USDOT and the General Services Administration (GSA) have stated that they will consider guidance for how to integrate AVs into public fleets. Maryland's leadership in this area may also be an opportunity to influence the broader framework of how governments adopt and manage new vehicle technologies through innovative fleet ownership.

GOAL(S) MET

4b and 5b-e

LEAD

OOC, OOM, and OTMO

WHEN

2-3 years

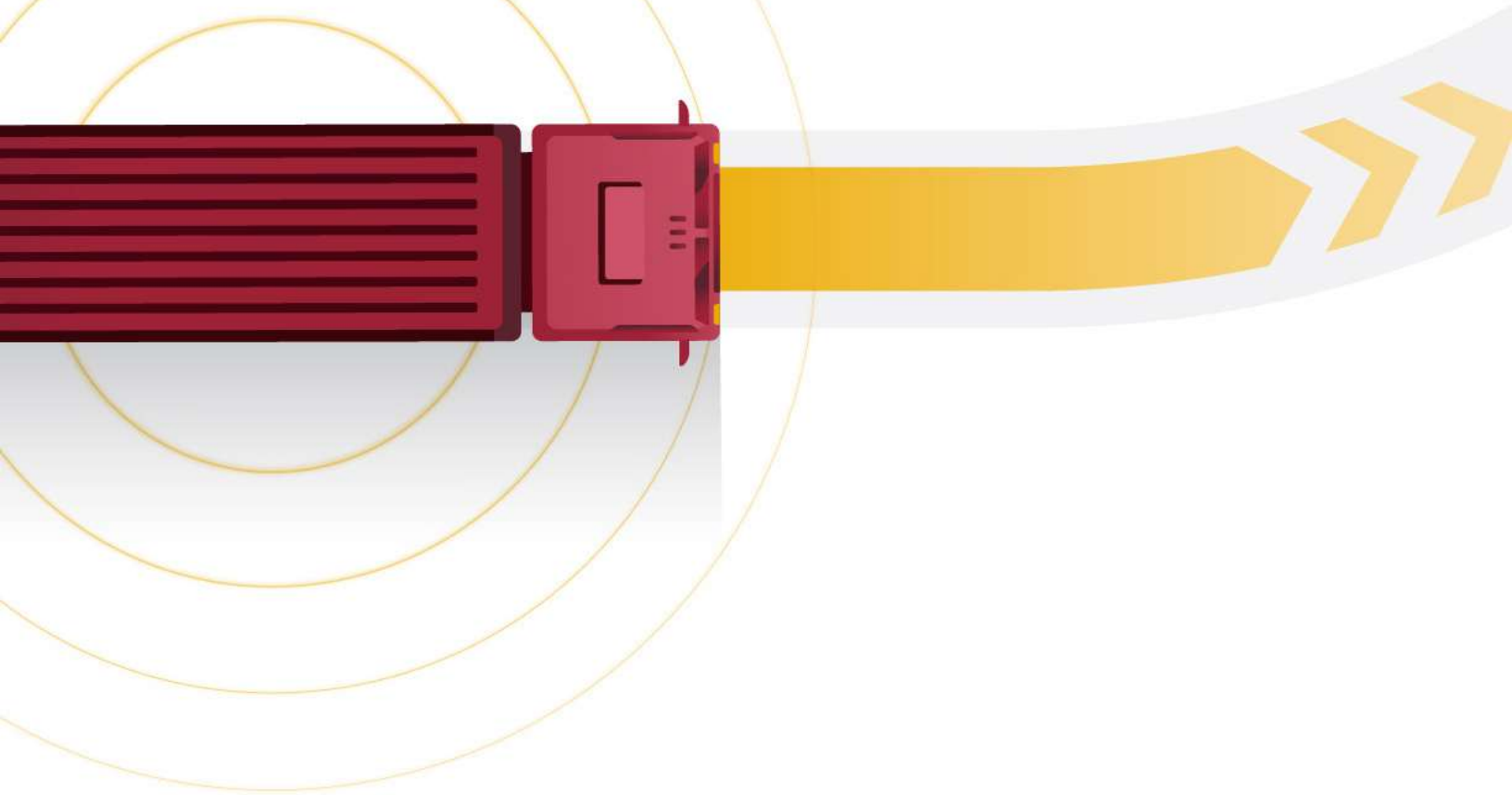
RESOURCES

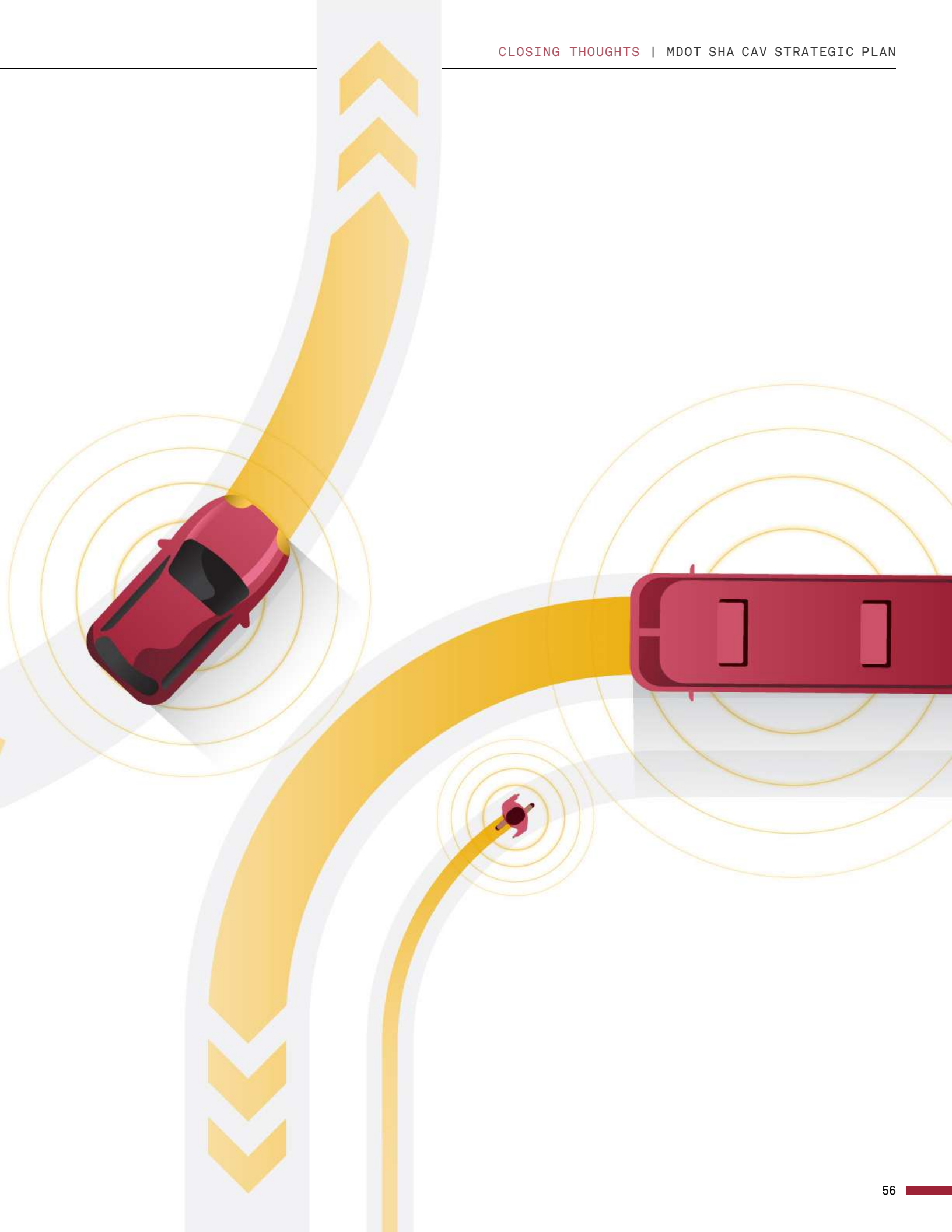
Staffing limited, and no funding is available.

Closing Thoughts

The CAV program within MDOT SHA advances solutions to help our communities travel safer, more efficiently, and more equitably. CAV technology has the potential to significantly increase safety, mobility, equity, efficiency, and public health by substantially decreasing human error and opening a new era of mobility solutions. While it is unclear when fully autonomous vehicles will be widespread on public roadways, the CAV industry will fundamentally change the way communities live. This Plan supports the larger Maryland CAV Strategic Framework by outlining specific strategies the MDOT SHA will implement in the next five years. Implementing these strategies is one of many steps needed to reach Maryland's future transportation ecosystem.

MDOT SHA continues to work together with its partners and the broader MDOT family to make our CAV Program a reality for the citizens of Maryland. We look forward to sharing our successes annually in the years to come and offering our customers a roadway network and technology infrastructure that can support the future of transportation.





Resources

TERMINOLOGY

CV PFS A Glossary of Connected and Automated Vehicle Terms

National Highway Institute: CAV training course

NATIONAL

USDOT ITS JPO Training Modules

USDOT ITS JPO Connected Vehicle Pilot Deployment Program

USDOT CARMA

USDOT Work Zone Data Exchange

USDOT NHTSA Technology & Innovation

USDOT NHTSA Levels of Automation

Eastern Transportation Coalition

Cooperative Automated Transportation Coalition

Connected Vehicle Pooled Fund Study Research Findings

American Association of State Highway and Transportation Officials Committee on Transportation System Operations

National Association of City Transportation Officials

National League of Cities

National Association of Counties

American Planning Association AV Resources

ITS America policy resources related to ITS and autonomous vehicles

Transportation Safety Advancement Group

STATE OF MARYLAND

Maryland Connected and Automated Vehicle Working Group

2020 Maryland CAV Strategic Framework

Maryland Strategic Highway Safety Plan

MDOT SHA CAV Page

MDOT SHA TSMO Master Plan

Larry Hogan, Governor
Boyd K. Rutherford, Lt. Governor
Gregory Slater, Secretary, Maryland Department of Transportation
Tim Smith, Administrator, MDOT State Highway Administration

2021-2025 MDOT SHA CAV Implementation Plan

The 2021-2025 MDOT SHA CAV Implementation Plan was produced by the MDOT SHA Office of Transportation Mobility and Operations with oversight from the MDOT SHA CAV Working Group.

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