

Maryland Department of Transportation State Highway Administration

Connected and Automated Vehicle

2018 Accomplishments & The Road Ahead



M**DOT** MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

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ORGANIZATIONAL MANAGEMENT OF CAV



New Deputy Director for TSMO & CAV and New Communications Division within the Office of CHART.

MDOT SHA CAV Working Group co-chaired by CHART and OPPE with representatives from various Offices and Districts.

Developed **Draft CAV Data Governance Chapter** for data that supports future CAV related applications.

CAV STRATEGIC ACTION PLAN

RELEASED **DEC 2017** WITH **35** RECOMMENDED ACTIONS

Progress made on **26** of those recommended actions in 2018!

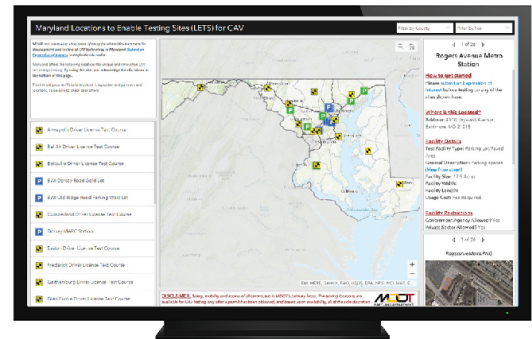
US-1 INNOVATIVE TECHNOLOGY DEPLOYMENT CORRIDOR

Completed a **comprehensive requirements document** for a proposed connected vehicle pilot project along US-1 with recommended ITS solutions to support incident and traffic management.



SUPPORTING CAV TESTING WITHIN THE STATE

Office of Planning and Preliminary Engineering developed and maintains the **Maryland Locations for Enabling Testing Sites (LETS)** web mapping application.



Facilitated CAV testing on MDOT SHA facilities including:

- STEER Tech autonomous vehicle parking
- olli Self Driving Shuttle

For the Maryland Police and Correctional Training Commissions' Public Safety Education and Training Center (Sykesville, MD), MDOT SHA developed a **comprehensive paper that outlined expansion and rehabilitation concepts** for a new next-generation Traffic Incident Management training course with CAV capabilities.

COMMUNICATION AND OUTREACH INITIATIVES

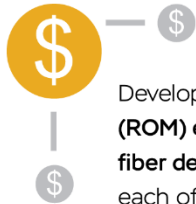


Developed **MDOT SHA CAV "Champions"** within MDOT SHA for participation in the CAV working group.

Developed **intranet site** and **CAV blog** to provide education and outreach along with internal collaboration tools.

PLANNING TOOLS AND MATERIALS RELATED TO CAVS

Developed interactive **CAV Public Policy in the US Story Map** to track monthly legislative actions related to CAV across the country.



Developed Rough Order of Magnitude (ROM) estimates for CAV technology and fiber deployment to be incorporated in each of MDOT SHA's CTP Projects.

Developed **Call for Projects Template** to solicit ideas for CAV projects across the agency.



TRAINING INITIATIVES

MDOT SHA co-hosted the FHWA **Connected Vehicle 201 training**.

MDOT SHA co-hosted the FHWA **Introduction to ARC-IT Architecture workshop**.



COORDINATION WITH MDOT CAV WORKING GROUP

Ongoing participation in **MDOT CAV Working Group, CAV Technical and Policy Subgroup, and CAV Freight Subgroup**.



Supported the development of responses to **4 Federal Requests for Comments** related to CAV initiatives.

NATIONAL INVOLVEMENT IN CAV ACTIVITIES

- ✓ **Cooperative Automated Transportation (CAT) Coalition**
- ✓ **Connected Vehicle Pooled Fund Study**
- ✓ **Dedicated Short Range Communications (DSRC) Community of Interest**
- ✓ **Intelligent Transportation Society (ITS) of America**
- ✓ **I-95 Corridor Coalition**



STATE HIGHWAY ADMINISTRATION



THE ROAD AHEAD

2019 PRIORITIES

In 2019, MDOT SHA intends to continue to build on last year's momentum and pursue activities in support of the strategies and recommendations outlined in the MDOT SHA CAV Strategic Action Plan.

1

SUPPORT CAV DEPLOYMENT EFFORTS

US-1, TSMO, as well as research and deployment grants.



DEVELOP TECHNOLOGY-BASED PROJECT LIST

Develop a CAV library to capture new and existing project ideas, and integrate ITS devices into planning tools.

2

3

DEVELOP AND MAINTAIN CAV EDUCATIONAL MATERIALS

Develop educational CAV materials for internal and external platforms including training materials, public policy, and public consumption.



SUSTAIN NATIONAL & REGIONAL INVOLVEMENT

Develop a plan for a new MDOT Local Agency CAV Sub Group, support statewide CAV testing, and attend local and national conferences.

4

5

PLANNING & BACKGROUND EFFORTS

Understand long term impact to Maryland and develop new interactive tools in support of planning. Build out CAV data inventory and explore opportunities for business process improvement.



STRATEGIC TELECOMMUNICATIONS PLAN & FIBER MAP

Complete Strategic Telecommunications Plan and circulate for comment. Work closely with MDOT and DOIT to develop a map inventory of locations with fiber across the State.

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Introduction

The Maryland Department of Transportation State Highway Administration (MDOT SHA) released a strategic action plan for connected & automated vehicles (CAV) in December 2017. The plan was built from a well-informed and well-defined approach to ensure MDOT SHA is prepared and engaged in CAV implementation, and to prepare its infrastructure, policy, and operations for the future.

The CAV Strategic Action plan defined several goals, each with strategy statements and actions that will enable MDOT SHA to achieve their vision and goals, while acknowledging and working within the uncertain environment that today's technology revolution demands.

Strategy Statement	Examples
Implement Pilot Programs to Build Experience and Attract Partners	Examples include a pilot corridor already defined along US 1 in Howard County, future pilot corridors aligned with other programs, and issues surrounding funding and related project efforts.
Get Additional Benefits by Supporting CAV Testing	Examples include partnering with the Aberdeen Proving Ground and the U.S. DOT, while leveraging relationships with various Maryland academic institutions and private companies interested in testing in Maryland.
Foundational Needs of a CAV Program	Examples include an emphasis on a robust telecommunications infrastructure, enhanced road markings and signage, policy & legislative issues, and a focus on data governance.
Outreach Activities	Examples include an internal and external outreach program, and continued involvement in national activities.
Organizational Management of CAV	Examples include an internal MDOT SHA CAV Working Group and active involvement in MDOT's larger working group.

This document walks through a high-level summary of Year One 2018 accomplishments and concludes with a brief discussion on 2019 priorities.

Year One Accomplishments

During the first year of the plan's implementation stage, there has been significant progress on 26 of the original 35 recommended actions. Examples of recommended actions include dramatic changes such as restructuring the internal hierarchy, developing comprehensive planning tools and material, conducting outreach and communications, and progressing on pilot programs.

As part of the overall CAV program effort, the first year was spent building a solid foundation for future initiatives. Internally, MDOT has worked to improve the efficiency and efficacy of their CAV-related initiatives and awareness. There have been critical planning efforts including development and first draft of a strategic telecommunications plan, a data governance plan specific to the influx of CAV data is now in review, and valuable training workshops.

The following section outlines - by key strategy area - our progress during 2018 on the CAV Strategic Action Plan recommended actions.

Implement Pilot Programs to Build Experience and Attract Partners

As new technology and strategy begins to form around CAV, it is important for agencies like MDOT SHA to gain experience and anticipate (as much as possible) future needs. Pilot programs are an excellent opportunity to provide some immediate benefits to citizens and consumers of transportation, while simultaneously building experience with next-generation technology, new partners, and future operational scenarios.

Several key strategies were identified in the Strategic Action Plan, beginning with the centerpiece of MDOT SHA's launch effort, the US 1 Innovative Technology Deployment Corridor.

Strategy 1: Implement the US 1 Innovative Technology Deployment Corridor

Recommended Action 1.1: Pursue the US 1 Innovative Technology Deployment Corridor

Description: *Vigorously pursue the US 1 Innovative Technology Deployment Corridor project to establish a solid foundation, demonstrate CAV readiness to the private industry, and gain valuable experience in multi-disciplinary projects that include CAV components.*

Activity in 2018:

- Completed a comprehensive requirements document providing an overview of current conditions along the corridor, recommended Intelligent Transportation Systems (ITS) solutions to support incident and traffic management, and a proposed connected vehicle pilot project to build MDOT SHA's knowledge and partnering capabilities in the CAV arena. Document included specific device and location recommendations, functional requirements, and key next steps discussion.
- Documented key ITS deployment recommendations, began work with MDOT SHA's Office of Traffic and Safety (OOTs) to advance those into the design & deployment stages, did initial field surveys to document needs, and established a schedule for design & advertisement.

Year One in Review: Connected and Automated Vehicle Strategic Action Plan

- Documented key issues surrounding the Connected Vehicle (CV) Pilot component, identified a procurement mechanism through the OOTS Signal Shop, identified locations for Road Side Unit (RSU) deployment, met with the Department of Information Technology (DOIT) to allay concerns over cybersecurity, and received a proposal from Econolite for purchase and deployment of RSUs.
- Coordinated the discussion and needs between Coordinated Highways Action Response Team (CHART) and OOTS Signal Shop.

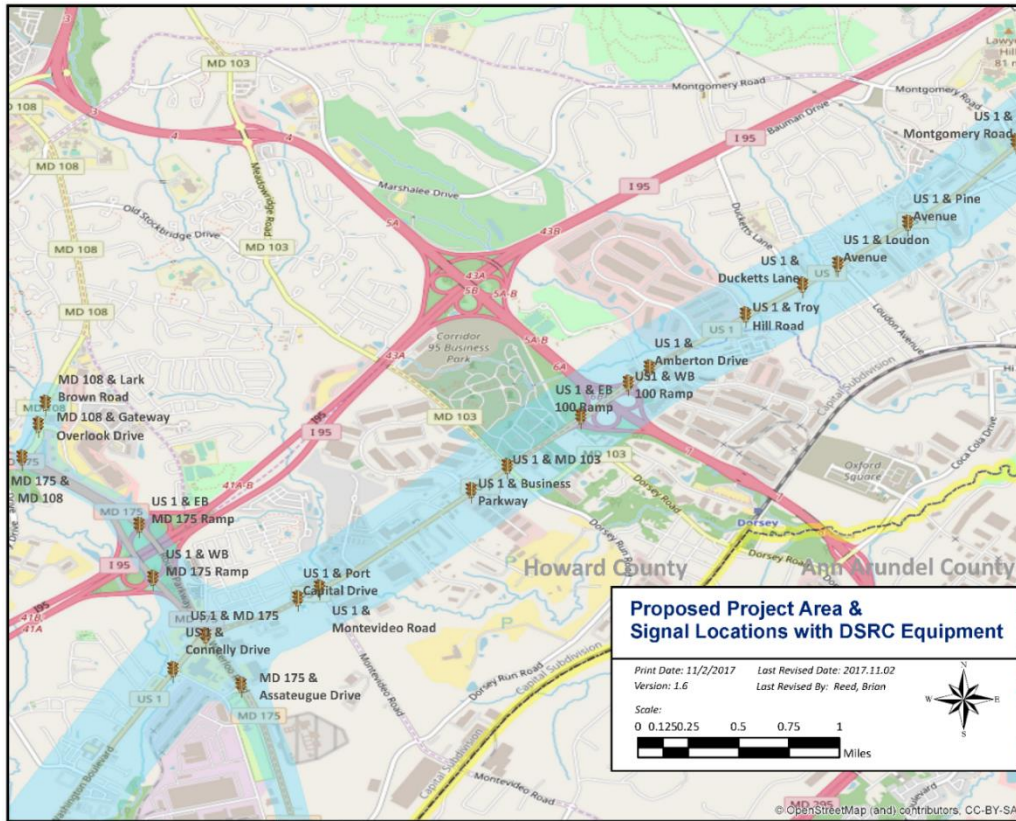


Figure 1: Map of Proposed CV Pilot RSU Locations from US 1 Requirements Document

Constraints:

- The Governor’s Smart Signal program deployment took precedence, thus RSU deployment has not yet occurred during year 1.
- A new Closed-Circuit Television (CCTV) camera specification was in progress, so deployment of ITS devices was temporarily slowed to allow this to complete its cycle.

Next Steps:

- Advance the design and advertisement of ITS devices.
- Advance the procurement of the CV Pilot portion in concert with the OOTS Signal Shop.
- Consider additional CV Pilot recommendations included in the requirements document produced by the Office of CHART and ITS Development.

Recommended Action 1.2: Implement back-haul data services for pilot

Description: *Implement back-haul data services for pilot to provide device monitoring (health and data quality) and provide message-set forwarding to a cloud data service for future analytics and CV application development.*

Activity in 2018:

- The US 1 CV pilot, previously mentioned, identified several key actions to be taken after initial deployment of RSUs including:
 - Simple Network Management Protocol (SNMP) Operations and Maintenance (O&M) and State of Health Monitoring
 - Data Management Plan coordinated with Data Governance planning efforts
 - Long-Term Device Test/Mock-up Test at Signal Shop and/or on Hanover Complex
 - Begin On-board Unit (OBU) Applications Development Early in the Process, and Not After the System is Deployed
 - Multi-Disciplinary Planning and Stakeholder Engagement

Constraints:

- Until the RSUs are deployed, no further action has been taken on the above steps.

Next Steps:

- Advance the procurement of the CV Pilot portion in concert with OOTS Signal Shop.
- Consider additional CV Pilot recommendations included in the requirements document produced by the Office of CHART and ITS Development.

Recommended Action 1.3: Document lessons learned from US 1 project

Description: *Document lessons learned from US 1 project for implementation in future projects.*

Activity in 2018:

- None

Constraints:

- Until the RSUs are deployed, no further action can be taken.

Next Steps:

- Advance the procurement of the CV Pilot portion in concert with OOTS Signal Shop.
- Begin documenting lessons learned.

Strategy 2: Implement Future Innovative Technology Deployment Corridors

Recommended Action 2.1: Develop scope for Aberdeen-area project

Description: *As soon as the US 1 Innovative Technology Deployment Corridor nears conclusion, MDOT SHA should begin scoping the Aberdeen area project. This will demonstrate to the Aberdeen Test Center (ATC) that MDOT SHA is a ready and willing partner and will afford the opportunity to partner with MDTA.*

Activity in 2018:

- None

Constraints:

- Delay of the US 1 project has slowed down future corridor planning.
- Coordination with Aberdeen has been challenging due to changing points of contact and military restrictions. Further discussions are being organized through the MDOT working group.

Next Steps:

- Advance the US 1 project to the point where we can then focus on the Harford County deployment of both ITS and CV Pilot solutions.
- Hold further discussions with Aberdeen through the MDOT working group.

Recommended Action 2.2: Meet annually to outline future deployment corridors

Description: *Once a year the internal MDOT SHA CAV Working Group should set a meeting with the sole purpose of outlining future deployment corridors. The group should review the progress and lessons learned from the US 1 and Aberdeen deployments, and consider what has changed in the prior months.*

Activity in 2018:

- Developed an online CAV Technology Deployment Dashboard that catalogs potential locations for CAV devices and associated costs.
- Estimated CAV deployment costs for individual Consolidated Transportation Program (CTP) projects to provide cost implications of including CAV technology in existing project funds.
- Developed a Call for Projects Template, circulated to MDOT SHA CAV Working Group.
- Developed a CAV Technology Matrix summarizing technology solutions available to address multi-modal challenges and improve safety, mobility, operations or economic impact.

Constraints:

- Team needs better understanding of project needs, lack of time to educate team and internal priorities.

Year One in Review: Connected and Automated Vehicle Strategic Action Plan

Next Steps:

- CAV Technology Deployment Dashboard CTP estimates have been updated to include assumed costs for fiber through coordination with CHART's new Communication Division, who is in contact with the Secretary's Office fiber coordinator.
- Develop innovative and engaging ways to generate enthusiasm to compile project ideas to share with leadership and ensure "on-the-shelf" readiness for deployment when funding is made available.

Recommended Action 2.3: Develop process to review requests from companies interested in testing in Maryland

Description: Periodically there will be requests for "one-offs" from companies that want to test in a specific location. The internal MDOT SHA CAV Working Group should develop a process for reviewing each opportunity for transparency and fairness and entertain all of those interested offers and discuss/explore what might be needed from an infrastructure standpoint.

Activity in 2018:

- The MDOT SHA team developed and is maintaining the [Maryland Location for Enabling Testing Sites \(LETS\)](#) web mapping application used by the MDOT working group intended to solicit ideas by the public or the industry. MDOT SHA provided several facilities to be included as potential sites for CAV testing.
- Parties interested in testing at an MDOT SHA facility can submit an Expression of Interest through the [MDOT CAV page](#). Representatives from MDOT SHA CHART and OPPE participate in the "triage" Committee for evaluating Expression of Interest submissions.
- The Maryland Product Evaluation List (MPEL) process for new technologies is currently being utilized for the review of potential CAV technologies.

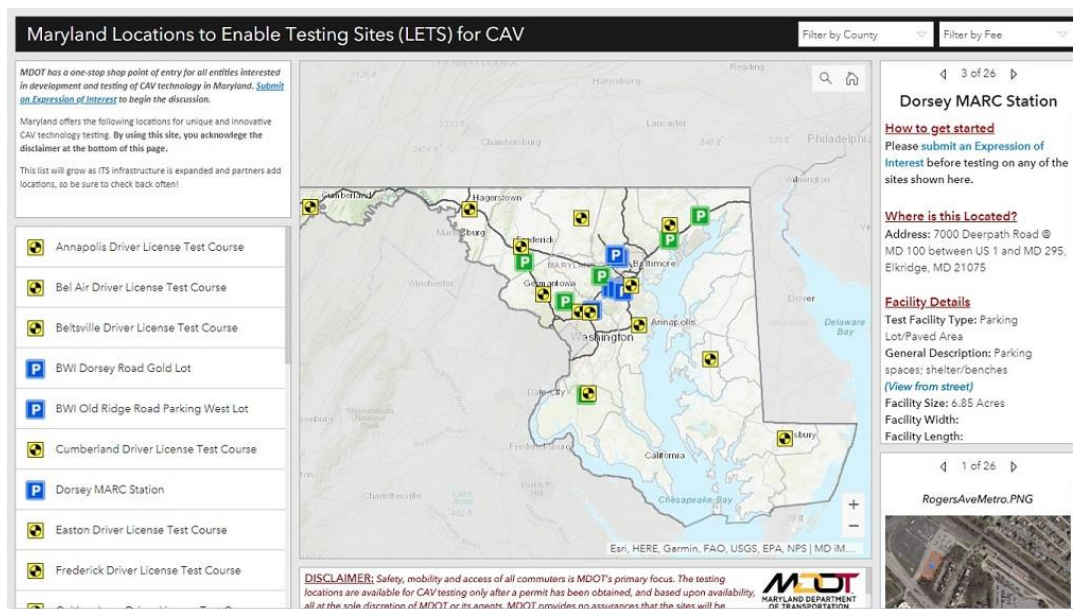


Figure 2: Screen capture from the Maryland Locations to Enable Testing Sites (LETS) for CAV

Constraints:

- MDOT SHA need to be further involved in the MPEL process to ensure technologies are not being missed that are related to CAV.

Next Steps:

- Working group to involve itself in MPEL process and request presence when technology is submitted. Members need to be willing to act as champions for deployment and product approval.

Recommended Action 2.4: Explore the possibility of an on-call based deployment contract

Description: *Explore the possibility of an on-call based deployment contract, so that as unique opportunities arise its value can be assessed and if worthwhile a mechanism to upgrade a specific location can be used to install either permanent or temporary DSRC or other CV communication technology.*

Activity in 2018:

- None

Constraints:

- Funding mechanism not available and lack of team knowledge on how to advance this type of action item.

Next Steps:

- Get examples from other States on their on-call CV deployment contracts to help gather ideas on sample contract language.
- Identify funding mechanism and/or source.
- Advance the development of a contract vehicle through leadership for approval.

Strategy 3: Coordinate with Ongoing Major Projects

Recommended Action 3.1: Explore opportunities that may enable future CAV implementation along I-270

Description: *Meet with the project team for the I-270 ICM project and discuss opportunities to include telecommunications (and/or conduit) that could enable future CAV implementation but don't change the scope or schedule of the current project. Similarly, inject future robust communications and conduit plans into the I-95 ATM project planning effort before it is advertised for construction.*

Activity in 2018:

- Team generally kept abreast of technologies being included in I-270 and I-695 projects.

Constraints:

- The I-95 Advanced Traffic Management (ATM) project has not advanced, but I-695 TSMO project has risen to upcoming advertisement status.

Next Steps:

- Task completed, next steps to focus on general agency wide efforts:
 - Continued presence by CHART in Transportation Systems Management and Operations (TSMO) project delivery to ensure technology is a baseline requirement for all projects.
 - Development of a Concept of Operations for ATM solutions, to help develop a better functional requirements-level agreement on future deployments between all stakeholders and to identify (if needed) what opportunities might arise for future connected vehicle applications.
 - Discuss integration of CAV with TSMO for project purpose and need.

Strategy 4: Pursue Federal Grant Opportunities

Recommended Action 4.1: Implement a program to create “on the shelf” projects with concepts fleshed out

Description: MDOT SHA should have a program in place that will have projects and ideas “on the shelf” with concepts fleshed out. Don’t wait for a grant opportunity to be published. Use the internal MDOT SHA CAV Working Group to identify possible projects and initiate an effort to develop the concepts further in anticipation of future federal grant NOFOs.

Activity in 2018:

- MDOT SHA submitted an Advanced Transportation and Congestion Management Technologies Deployment (ATCMTD) grant application in 2018 and is exploring opportunities for State Transportation Innovation Council (STIC) and other federal grants.
- Brainstorming sessions were held at two MDOT SHA CAV Working Group meetings to identify potential projects for grant applications.
- Developed a Call for Projects Template to be used to compile a list of projects where CAV Technology may be useful. This will remain an ongoing agenda item at internal working group meetings.

Constraints:

- Considered submitting for the Freight Platooning grant, but lack of resources and Maryland’s potential lack of readiness resulted in a no-go.
- A recent bill was submitted to the Maryland 2019 legislative session that would have reversed the existing block on truck platooning in Maryland, but the bill was rejected. Therefore, truck platooning is still a legal constraint for the State.
- Uncertainty in US DOT grant notice of funding requests makes it difficult to plan resource needs.

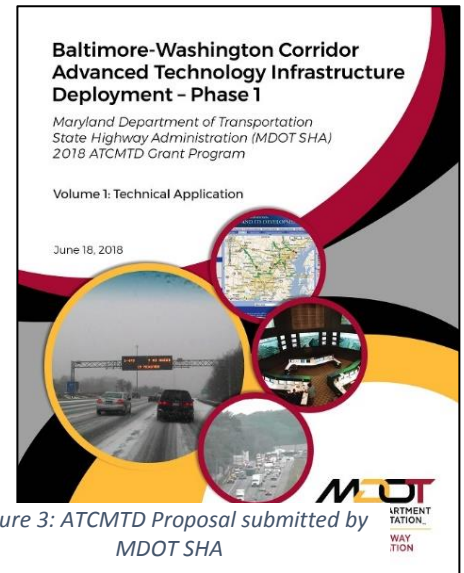


Figure 3: ATCMTD Proposal submitted by MDOT SHA

Next Steps:

- Develop a deeper cache of project concepts, each with some amount of detail included.
- Demonstrate readiness by including technology in projects going out for bid.

Recommended Action 4.2: Clarify role of consultants in supporting grant application development

Description: *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.*

Activity in 2018:

- Discussed with Assistant Attorney General, the decision was that MDOT SHA should currently review each opportunity on a per situation basis.
- In working with TSO, work group members identified an opportunity to potentially post grants directly on TSO website, like other federal grants. This could remove the potential exclusion concern.

Constraints:

- None Identified.

Next Steps:

- Task complete. Solutions described above.

Get Additional Benefits by Supporting CAV Testing

While pilot programs are excellent opportunities to build experience internally, there are also many opportunities to partner with other organizations already established as research, development, and testing centers. This once again shifts the risk away from MDOT SHA while offering an opportunity to share the reward.

Strategy 5: Partnerships

Recommended Action 5.1: Maintain and grow relationship with Aberdeen Proving Ground

Description: *Maintain and grow relationship with Aberdeen Proving Ground to explore potential collaborative efforts for CAV testing. The FHWA and other companies will conduct testing on closed-loop courses contained in ATC but could expand that test to include real-world roadways and even the potential for mixed-traffic situations on public Maryland roadways.*

Activity in 2018:

- Aberdeen’s test track is restrictive, and their ability to share/deploy with us is limited to military willingness, not much is possible through them.
- Shifting focus to partnering more through the Federal Highway Administration (FHWA) to mitigate constraints with Aberdeen. MDOT TSO is taking the lead on development of a Partnering Agreement with the U.S. DOT agencies (FTA, FHWA, etc.) to encourage pilot testing throughout Maryland and possibly at Aberdeen Test Center (via U.S. DOT).

Constraints:

- ATC is a difficult place to test due to military restrictions.
- Focusing on roadways outside of ATC will result in a joint MDOT SHA/MDTA effort, requiring additional coordination, cost sharing, legal/policy, and resource allocation.

Next Steps:

- Once TSO develops the Partnering Agreement with U.S. DOT, there is a higher expectation of pilot deployments.

Recommended Action 5.2: Explore relationship with Maryland PCTC Public Safety Education and Training Center

Description: Explore possible relationship with Maryland Police and Correctional Training Commissions (PCTC) Public Safety Education and Training Center in Sykesville, MD – This facility provides mock city and traffic scenarios for testing.

Activity in 2018:

- Developed a comprehensive paper that outlined expansion and rehabilitation concepts based on the input of likely driver training facility (DTF) users for a new next-generation Traffic Incident Management (TIM) training course with CAV capabilities.

Year One in Review: Connected and Automated Vehicle Strategic Action Plan

- Similar functionalities with other innovative and emerging TIM facilities around the country were documented in the paper, along with concepts to accommodate incremental capacity increases, construction schedules, and funding availabilities.
- Circulated the paper among MDOT SHA leadership for review.

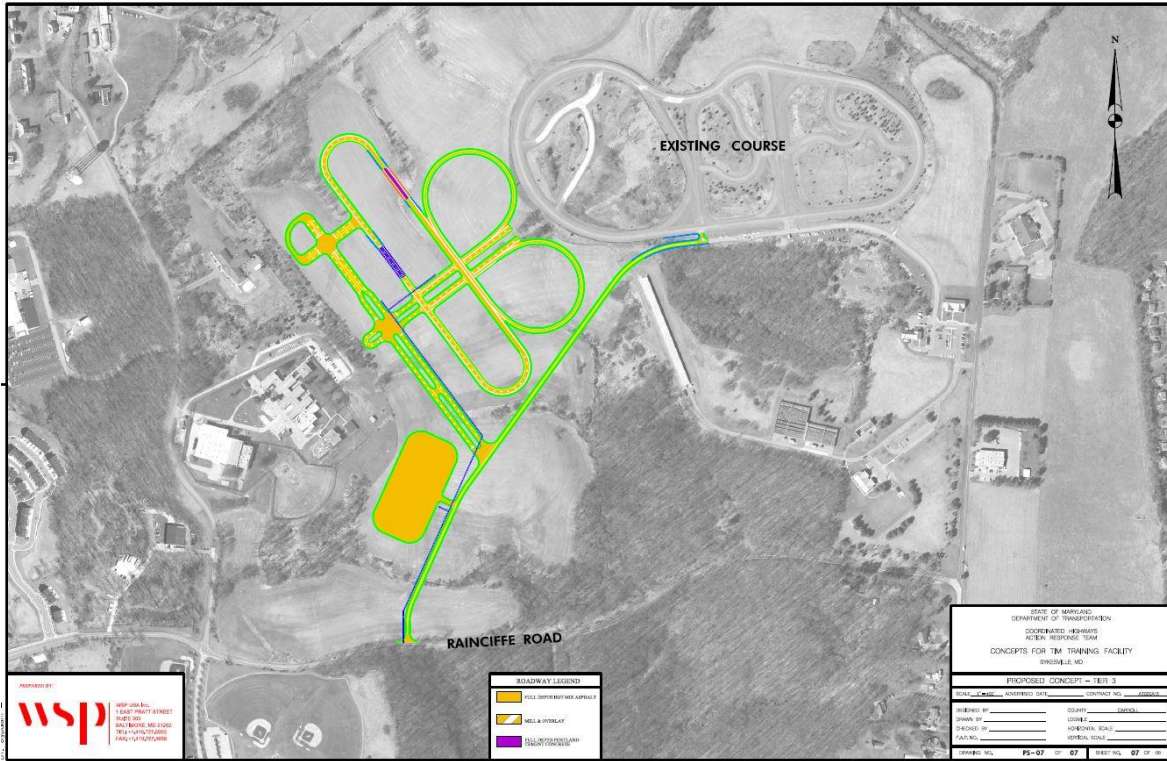


Figure 4: Conceptual Plan for expansion/rehabilitation of Driver Training Facility

Constraints:

- Need for continued funds to maintain pavement conditions.
- Multiple agencies would be involved in the partnership, making it a complicated exploratory exercise.

Next Steps:

- Continue to explore the possibility of implementing one or more of the concepts documented in the paper.
- Continue to monitor the progress of other CAV test facilities, in particular those that serve both TIM and CAV capability sets.

Foundational Needs of a CAV Program

There are several foundational efforts identified in the CAV Strategic Action plan that will ensure MDOT SHA remains nimble yet grounded in the need to provide ongoing benefits to the citizens of Maryland.

Strategy 6: Install a Robust Telecommunications Infrastructure

Recommended Action 6.1: Develop a Strategic Telecommunications Plan

Description: *Develop a strategic telecommunications plan – The effort should include an analysis of the technological challenges and opportunities that exist today, acknowledging that we can't possibly predict what the next great evolution in communications might reveal. Those policy issues would also include ops, maintenance, and ownership relationships in terms of MDOT SHA vs MDOT vs Network Maryland.*

Activity in 2018:

- MDOT SHA created a new division within the Office of CHART to focus on Communications, and appointed Janet Frenkil as Division Chief.
- As part of the strategic telecommunications plan effort, the on-call consultant team has developed an inventory of existing and recommended network needs.

Constraints:

- The last statewide Telecommunications Plan was published in 1998 and technology has significantly outpaced the Plan.
- Need for a flexible plan able to adapt to new technologies and benefits.
- Other competing priorities have delayed the start of this effort.

Next Steps:

- CHART's Communication Division will wrap-up the telecommunications plan and circulate to the MDOT SHA CAV Working Group for information and comment.

Recommended Action 6.2: Build provisions of communications infrastructure into all future roadway projects

Description: *As a parallel to developing a telecommunications plan and architecture, MDOT SHA should also work to build provisions of this communications infrastructure into all roadway projects going forward to support CAV deployment in the future. Conduit for fiber optic/wired communications should become commonplace, and additional physical cabinet space at ITS and traffic signal installations should be assumed to house future equipment.*

Activity in 2018:

- Used the CHART Board as an opportunity to stage a facilitated discussion on whether to include Conduit/Fiber for future use in all MDOT SHA Construction Projects. After the CHART Board responded favorably to such a move, verbal approval was received from MDOT SHA Leadership and a policy is currently being written.

Year One in Review: Connected and Automated Vehicle Strategic Action Plan

- MDOT SHA is working closely with MDOT and DOIT to develop a map inventory of locations with fiber optic cable across the State.

Constraints:

- None identified.

Next Steps:

- Most new projects will include language that encourages empty conduit and/or dark fiber, depending on potential needs that will be determined through coordination between OHD and CHART TSMO leaders.

Strategy 7: Enhance Road Markings and Signage

Recommended Action 7.1: Monitor national research and discuss merits of modifying road marking and signage program

Description: *Monitor national research such as NCHRP 20-102(06) Road Markings for Machine Vision, and NCHRP 20-24(112) Connected Road Classification System, along with lessons learned from other states such as Caltrans, and periodically discuss the merits of making changes to your existing road marking and signage program. The MDOT SHA CAV Working Group should visit this topic annually with the Deputy Administrator/Chief Engineer for Operations.*

Activity in 2018:

- MDOT SHA continues to monitor national research through webinars, CAV and ITS conferences, and the Connected Vehicle Pooled Fund Study.
- OOTS has recently engaged in the National Committee for Uniform Traffic Control Devices (NCUTCD) where a CAV working group has formed to address signs, markings, and traffic impacts.
- MDOT SHA consultants are also engaged in several national activities and provide regular updates.

Constraints:

- FHWA will pursue an update to the 2009 MUTCD that will include a focus on CAV impacts, opening the door to an opportunity for MDOT SHA to help shape national policy.

Next Steps:

- Continue to engage in the NCUTCD and monitor other ongoing national (and international) research on road markings and signage as it relates to CAV development.

Strategy 8: Track and Influence Policy & Legislation

Recommended Action 8.1: Develop a bicameral policy briefing for interested Maryland State Legislators

Description: *Develop a bicameral policy briefing for interested Maryland State Legislators outside of the session (i.e., prior to the start of the 2018 session, and repeat in future years with updates). Secure one or more champions in each house of the assembly, encourage open discussion on potentially restrictive ideas that could be born out of lack of understanding, and discuss whether legislation is necessary.*

Activity in 2018:

- Legislative briefing draft created by Office of Policy and Research, currently being reviewed by working group leadership for comments.
- MVA currently briefs legislature on a per-request basis.

Constraints:

- Current approach is passive vs active, resulting in issues such as the truck platooning bill being rejected this year, potentially because of lack of understanding of technology.

Next Steps:

- Bring MDOT SHA leadership up to speed and evaluate interest in sponsoring legislative briefings.

Recommended Action 8.2: Monitor state and federal legislative actions and provide periodic briefs to interested parties

Activity in 2018:

- MDOT SHA developed and maintains a [CAV Public Policy across the US](#) story map to track legislative actions related to CAV across the country. The site is updated monthly.
- The National Conference of State Legislators also tracks policy and legislation.
- MDOT SHA's consultants continue to track federal, state, and local policy and legislative activities related to CAV

Constraints:

- None identified.

Next Steps:

- Continue updating website.
- Continue awareness of federal, state, and local activities



Figure 5: Screen Capture from the CAV Public Policy Across the US Story Map

Strategy 9: Develop a Robust Data Governance Plan

Recommended Action 9.1: Define a data governance plan specific to CAV data

Description: Undertake a comprehensive effort to define a data governance plan specific to CAV data. Look for balance between technical and institutional barriers and opportunities, while considering the execution and enforcement of authority over the management of data assets and the performance of data functions.

Activity in 2018:

- Office of Planning and Preliminary Engineering (OPPE) developed a DRAFT CAV Data Governance document which has been shared with the internal working group for review and comment.
- The document includes data governance goals, definitions, policies, standards, and procedures.
- It has already been reviewed by OPPE leadership and template is being used for other data governance fields.

Constraints:

- None Identified.

Next Steps:

- Data Governance to be managed by OPPE, but expected CAV working group next steps include:
 - Outreach to internal users and external CAV data owners to gather their feedback and continue development of the overall data governance strategy.
 - As CV pilot projects begin to unfold, periodically evaluate the plan with a “reality check” given real-world data exchange (input/output).

Strategy 10: Pay Attention to Staffing and Skills Development

Recommended Action 10.1: Assess staffing needs as well as training/skill development needs

Description: *Periodically review staffing needs and training/skill development needs. Consider the merits of internal growth versus outsourcing, and always maintain the viewpoint that leading-edge support is necessary to foster a culture of innovation among staff and contract support alike.*

Activity in 2018:

- Made external training opportunities available to staff, such as the CV 201 and ITS Architecture workshops.
- Continued to engage technical staff in discussions concerning future technology needs.

Constraints:

- None Identified.

Next Steps:

- Keep the systems integration team engaged in all future technology explorations and continue liaison with DOIT to ensure IT staff are part of the planning and early exploration - not just inheriting new technology and having to adapt.
- Expected to develop educational material for staff to better understand how CAV may affect their duties as well as creating materials for public consumption.

Recommended Action 10.2: Integrate CAV into MDOT SHA's organizational modernization efforts

Description: Integrate (where possible) CAV into MDOT SHA's ongoing efforts for organizational modernization analysis.

Activity in 2018:

- The TSMO Strategic Plan includes allowances for CAV integration with other organizational modernization analyses. Recent internal organizational changes reflect future needs in CAV (and are discussed in a later strategy).

Constraints:

- None Identified.

Next Steps:

- None Identified.

Outreach Activities

An important outcome from MDOT SHA's TSMO program and the MDOT CAV Working Group was the recognition that success would depend on effective communication and outreach. The media may be talking about driverless and autonomous vehicles, but a relatively small percentage of internal employees, policymakers, and the traveling public have a good understanding of just how complicated (and near term) connected and AV systems are.

Strategy 11: Internal Awareness of CAV

Recommended Action 11.1: Develop CAV Communications Plan

Description: *Develop an internal communications plan for MDOT SHA (with recommendations for MDOT and other TBUs) to propose a series of strategies, messages, and tactics to communicate CAV updates as well as MDOT SHA involvement in CAV efforts and how this fits into the overall TSMO program.*

Activity in 2018:

- Developed a comprehensive CAV Communications Plan for internal as well as external outreach.
- CAV Champions have been identified across the MDOT SHA organization and engaged in the CAV Working Group.

Constraints:

- None Identified.

Next Steps:

- Finalize CAV 101 educational material for use in CAV training opportunities.
- Engage in additional outreach within MDOT SHA.

Recommended Action 11.2: Develop and maintain a library of internal CAV materials

Description: *Develop and maintain a library of internal materials to support MDOT SHA technical and executive staff in preparing for speaking engagements. This can be offered to other TBUs if interested.*

Activity in 2018:

- Developed internal [MDOT SHA CAV SharePoint site](#), with features such as the [CAV Blog](#), [CAV Forum](#) and other resources and outreach materials.
- A generic PowerPoint slide deck was developed for the CAV Strategic Plan.

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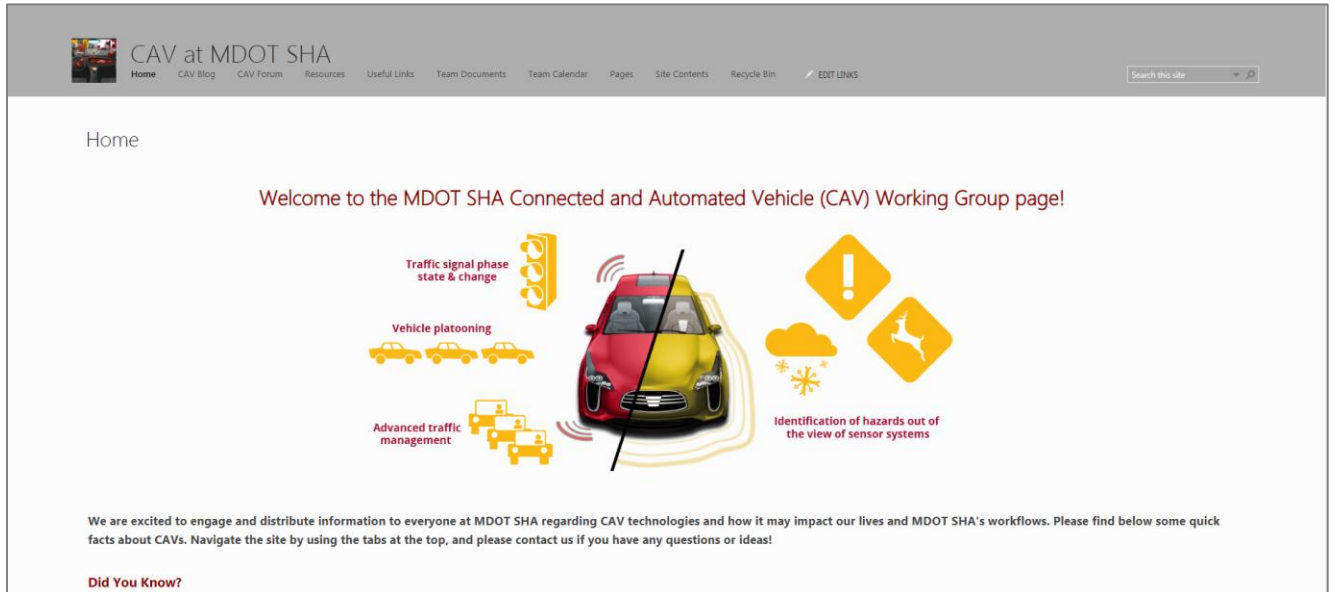


Figure 6: Internal CAV SharePoint Page

Constraints:

- Site is passive, requiring employees to be interested in order to engage in it.

Next Steps:

- Finalizing presentation material for leadership.
- Finalizing material for TSMO “road show” in Spring 2019 that includes CAV material.
- Engaging users through alternative methods, such as better coordination with MDOT SHA’s Office of Communication.

Recommended Action 11.3: Get CAV onto the agenda of key internal meetings and gatherings

Description: Get this topic onto the agenda of key internal meetings and gatherings (e.g., CHART Board) among various departments, and offer the opportunity to brief other TBUs.

Activity in 2018:

- CAV is now a regular part of the CHART board agenda.
- MDOT SHA is included in statewide CAV Working Group agenda.
- There is a CAV Task Force as part of the TSMO Working Group.

Constraints:

- None Identified.

Next Steps:

- Include in other agency-wide meetings.

Strategy 12: External Outreach & Education

Recommended Action 12.1: Develop a website that highlights Maryland's emphasis on technology and transportation

Description: *Develop a website within MDOT that profiles Maryland's emphasis on technology and transportation. The website can be a portal for companies thinking of doing business in Maryland (to learn more) or can be as simple as reinforcing our posture as a leading-edge high-tech state willing to help all companies and their employees get to where they want to be. Quality of Life is good for all employees.*

Activity in 2018:

- MDOT MVA is the sole lead on public-facing CAV initiatives. As a result, MDOT SHA has specifically been requested not to create a CAV specific website that would detract users from the MVA page.
- In the meantime, MDOT SHA developed and released a website specific to the MDOT SHA CAV Strategic Action Plan, summarizing our goals and objectives, and ongoing activities.

Constraints:

- None Identified.

Next Steps:

- Task complete.

Recommended Action 12.2: Assess economic impacts of CAV in Maryland and develop outreach strategy

Description: *Assess the economic impacts of CAV in Maryland and develop an economic development outreach strategy. Identify a handful of companies and target outreach/focus group discussions to better understand their needs and concerns.*

Activity in 2018:

- Developed a scope for Scenario Planning for CAVs which will include a literature review and workshop engaging stakeholders in the public and private sector.
- Supported MDOT in their production of "informational flyers" that both define CAV and introduce business opportunities in Maryland.

Constraints:

- Funding and resources for a large-scale scenario planning effort that encompasses local jurisdictions.

Next Steps:

- Scenario planning scope needs to be refined to align with TSO and agency goals. Scope was developed in conjunction with TSO and is expected to start end of February.

Strategy 13: Involvement/Visibility in National Activities

Recommended Action 13.1: Engage in national research activities

Description: *Engagement in other national research activities such as NCHRP 20-102 or by taking part in the annual Automated Vehicle Symposium co-sponsored by the Transportation Research Board and AUVSI.*

Activity in 2018:

- MDOT SHA currently involved in CV Pooled Fund Study (PFS).
- Submitted to be a Technical Advisory Committee (TAC) member for CAV.
- Joey Sagal was part of a panel at the 2018 Automated Vehicle Symposium (AVS) conference in San Francisco, and several other conferences throughout the nation.

Constraints:

- None Identified.

Next Steps:

- Continue to explore opportunities to stay engaged in national research and representation.

Recommended Action 13.2: Get involved with the national V2I Deployment Coalition

Description: *Involvement with the national V2I Deployment Coalition (now called Cooperative Automated Transportation (CAT) Coalition), opening the door to increased knowledge and partnership opportunities.*

Activity in 2018:

- Joey Sagal and Subrat Mahapatra have remained active in the CAT Coalition and are engaging others while also sharing information internally.

Constraints:

- None Identified.

Next Steps:

- Continue to explore opportunities to stay engaged in national research and representation.

Recommended Action 13.3: Engage in national conferences related to CAV

Description: *Engagement in national conferences that highlight technology and operational enhancements, sponsored by groups such as the ITE or ITS America.*

Activity in 2018:

- Joey Sagal provided an overview of MDOT SHA's CAV Strategic Action Plan as part of a panel at the 2018 ITS America Meeting in Detroit.

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- MDOT SHA staff attended the Florida AV Summit (along with MDTA staff) and also participated in field demonstrations.
- MDOT SHA staff are engaged in helping organize the 2019 ITS America Meeting.

Constraints:

- None Identified.

Next Steps:

- MDOT SHA will be a gold sponsor at the 2019 ITS America Annual Meeting in Washington, DC., staff should also submit paper/panel ideas.

Recommended Action 13.4: Encourage staff participation in local industry associations

Description: *Encourage staff participation in local industry associations (ITE, ITS Maryland, ASHE, etc.) where updates of national significance often are shared at the local level.*

Activity in 2018:

- MDOT SHA co-hosted several events with ITS Maryland and FHWA:
 - Connected Vehicle 201 Training (ITS Maryland)
 - Introduction to ARC-IT Architecture workshop (FHWA)

Constraints:

- None Identified.

Next Steps:

- Continue involvement and look for leadership opportunities.

Recommended Action 13.5: Look for opportunities to partner with neighboring states and agencies

Description: *Look for opportunities to partner with neighboring states and agencies in pursuit of minimizing risks while sharing rewards.*

Activity in 2018:

- Outreach to DeIDOT
- Outreach to VDOT
- Outreach to FHWA Turner Fairbank & Volpe
 - Visited Turner Fairbank and opened partnership opportunity with their research team

Constraints:

- None Identified.

Next Steps:

- Further and consistent involvement with neighboring states

Organizational Management of CAV

Now that the internal MDOT SHA CAV Working Group has been established, there is an opportunity to increase the engagement of all offices and departments within MDOT SHA.

Strategy 14: MDOT SHA Offices and Engagement in CAV

Recommended Action 14.1: Support from Executive Management

Description: *Executive management should periodically receive briefings from the internal MDOT SHA CAV Working Group, strongly support its efforts, and annually review whether the current internal organizational structure is meeting the needs of the program. Alternative organizational arrangements—such as creating a dedicated position somewhere within MDOT SHA whose full-time job is focused on CAV coordination—might be a future consideration.*

Activity in 2018:

- Created (and filled) a new position within the Office of CHART and ITS Development for the Deputy Director – TSMO, to officially serve as MDOT SHA's TSMO Program Manager and assist the Director with other initiatives, to include Connected and Automated Vehicle (CAV) initiatives.

Constraints:

- Disconnect in leadership involvement and engagement sometimes leads to “surprises” or “unknowns” (e.g. 5G and microcells).

Next Steps:

- Development of a plan to continue engaging MDOT SHA leadership in CAV activities to ensure their ability to answer CAV questions and support staff in pursuing CAV initiatives.

Other Accomplishments

The rapid pace of technological innovation with respect to CAV requires owners and operators of roadway infrastructure to adopt policies and programs to accommodate the vehicles of the future. To do so, requires the administration to welcome new and innovative practices, in some instances above and beyond what was originally part of the CAV Strategic Action Plan.

STEER Tech Autonomous Testing

The emerging CAV industry could have a positive effect on local job creation, talent retention, economic development, and improve the quality of life throughout the state. Committed to delivering on the Governor’s pledge that Maryland is “Open for Business,” the MDOT SHA was proud that another key accomplishment during this first year included partnership with STEER Tech.

MDOT SHA Administrator Greg Slater was interviewed by WBAL-TV as part of a story done on STEER Tech’s initial launch, and Secretary Pete Rahn was also engaged in a number of high-profile interviews in support of the Howard County start-up company working on AV technology.

Their application – an automated valet parking function – was initially tested on MDOT properties for closed-course evaluation for several months, and broader testing will continue to unfold in the future. Utilizing a portion of a Park-N-Ride lot that typically had available space, STEER Tech was able to put their vehicles and technology through a number of test scenarios and bring together key officials ahead of the public launch.

Not only did this partnership encourage a local Maryland company to evaluate its efforts, but it led to other MDOT TBUs having the ability to engage with STEER Tech and consider whether they wanted to also participate in further pilot testing.



Figure 7: Auto valet by STEER Tech

Expressions of Interest to MDOT

The success of the STEER Tech pilot testing was the first permitted AV testing done on MDOT property - but it certainly won’t be the last. Around the same time that MDOT SHA was completing their CAV Strategic Action Plan, the MDOT CAV Working Group published an official procedure to allow non-MDOT testing of highly automated vehicles on all its facilities. The process is focused on keeping the safety of the traveling public as its first and highest priority. However, the process is also designed to foster dialogue with companies or organizations that want to potentially test AVs and to help MDOT staff to better understand the needs and potential impacts to existing transportation systems

MDOT SHA participated in the review of 15 companies wishing to engage or deploy CAV technologies in Maryland during 2018, alongside other MDOT TBUs. The intent of the dialogue is meant to be collaborative,



Figure 8: Public Demonstrations of Olli by Local Motors

constructive, and expedient, and in some instances that conversation continued to the deployment stage. For example, Local Motors began operating their Olli low-speed AV shuttle in and around National Harbor late in the year and did a public demonstration at M&T Bank Stadium parking lot in conjunction with a large conference sponsored by the International Bridge, Tunnel, and Toll Association. During 2019, MDOT SHA will continue to engage with Local Motors as they pilot test the Olli shuttle in other locations around Maryland. Staff will also engage with local governments in pursuit of considering signage and road marking needs, pedestrian movements, and other use case scenarios for the Olli.

Public Comments on Federal Issues

MDOT SHA has a seat at the table for the MDOT CAV Working Group, and frequently plays a significant role in helping the agency respond to federal/national issues where public comments are permitted or encouraged.

During 2018, a number of those situations came up where MDOT SHA staff worked in concert with other MDOT TBUs to provide comments. Those included:

- Request for Information (RFI) on Integration of ADS into the Highway Transportation System from the FHWA
- Request for Comments (RFC) on Automated Transit Buses Research Program from the Federal Transit Administration (FTA)
- RFC on Removing Barriers to Transit Bus Automation from the FTA
- RFC on Removing Regulatory Barriers for Automated Vehicles from National Highway Transportation Safety Administration (NHTSA)
- Letter to the Federal Communications Commission (FCC) in support of the 5.9 GHz Safety Spectrum
- Reply to Governors Highway Safety Association (GHSA) Survey on CAV
- RFC regarding Federal Motor Vehicle Safety Standards (FMVSS) from US DOT
- Public Comments on Automated Vehicles 3.0 Guidance from US DOT
- Response to open comment request to the FCC concerning the Phase 1 Testing of Spectrum Sharing

MDOT SHA Staff also participated in FHWA's National Dialogue on Highway Automation, attending 2 of the 6 workshops held around the country. These workshops were dedicated to exploring a variety of CAV issues and gathering stakeholder input, which will undoubtedly impact future US DOT research efforts and presumably the 2019 update to their AV Guidance documents.

MDOT TSO Strategic Plan and Statewide Vision

The MDOT CAV Working Group, supported by MDOT TSO personnel, embarked upon a visioning exercise and development of an overall MDOT CAV Strategic Plan during 2018.

A vision statement was developed and adopted by the working group as follows:

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.

This is a vision for the State of Maryland and was developed in coordination with MDOT's partners to provide the State with a concept for moving forward in a connected and automated world. Following the development of a statewide vision, MDOT TSO has also embarked upon development of a Strategic Plan specific to MDOT.

The plan, still in final development stages, was based on outreach and collaboration with staff across all MDOT TBUs as well as external stakeholders and partners in the State. The full Plan includes:

- Lessons learned through technical outreach interviews with all MDOT TBUs
- A review of Maryland plans and initiatives related to CAV
- A scan of national and peer state best practices in CAV
- A series of focused CAV policy/research evaluations
- A summary of CAV challenges and opportunities in Maryland
- A detailed listing of recommended CAV strategies for Maryland
- An implementation roadmap for identified strategies

A final version of the MDOT CAV Strategic Plan will be available during 2019.

2019 Priorities

In 2019, MDOT SHA intends to continue to build on last year's momentum and pursue activities in support of the strategies and recommendations outlined in the CAV Strategic Action Plan. This year's focus will be to:

- Lay out the pathways to deployment and drive an increased push for CV technology applications;
- Develop educational materials for both internal and external stakeholders; and
- Accomplish other recommended actions in the CAV Strategic Action Plan.

Planned activities align to priorities as described below:

#1: Support CAV Deployment Efforts

- US-1 Innovative Technology Deployment Corridor
 - Advance the CV elements of the US-1 pilot project based on the recommendations outlined in the requirements document. The requirements document provides an overview of current conditions along the corridor, recommended ITS solutions to support incident and traffic management, and a proposed connected vehicle pilot project to build MDOT SHA's knowledge and partnering capabilities in the CAV arena.
- Include CV technologies in TSMO initiatives
 - Remain closely engaged with TSMO efforts through engagement and coordination in the CAV Task Force of the TSMO Working Group.
 - Explore opportunities for inclusion of CV technologies on TSMO projects.
 - Align and coordinate CAV Planning efforts with TSMO Planning efforts.
- Apply for grants that might support CAV research and deployment
 - Continue evaluating grant opportunities such as STIC, IDEA, ATCMTD, ADS, etc. and develop applications as appropriate.

#2: Develop Technology-based Project List

- Develop a library of potential CV technology projects that can be used for grant applications or TSMO projects.
- Work with MDOT SHA CAV Working Group to fill out the "Call for Projects Template" to capture an existing project or ideas for a new project that would benefit from connected or smart technologies.
- Integrate existing ITS devices into planning tools such as CAV Technology Deployment application.

#3: Develop and Maintain CAV Educational Materials

- Develop internal educational "CAV 101" material for staff in the form of a "cornerstone" class that employees can take. Materials would cover fundamental concepts related to CAVs such as types of vehicle equipment, roadside infrastructure, communication pathways, levels of automation, and real-world applications.
- Develop CAV-related materials in support of the Spring 2019 TSMO "road show".
- Maintain CAV in Public Policy across the US story map.
- Issue final version of bicameral legislative briefing on CAVs to educate state representatives and keep them informed about CAV developments.

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- Develop external/public facing materials for general public understanding.

#4: Sustain National & Regional Involvement

- Develop a plan for a new MDOT Local Agency CAV Sub Group and participate in a leadership capacity
 - The objective of this group is to keep local jurisdictions (cities, towns, counties), MPOs and other applicable agencies/institutions informed and involved with state policy, technology, and infrastructure development relating to CAVs through regular communication and opportunities to collaborate.
- Continue supporting CAV testing within the State through MDOT's Expression of Interest process.
- Attend and/or participate on panels at local and national conferences such as ITS Maryland, ITS America, Automated Vehicle Summit, etc.

#5: Planning & Background Efforts

- Develop an economic scenario plan for better understanding of CAV impacts to Maryland – Based on the scope of services outline, develop a plan that identifies regional metrics, explores economic impacts in land use, and utilizes scenario building workshops and regional demand modeling.
- Maintain existing and develop new interactive tools in support of planning for CAVs.
- Build out CAV Data Governance data inventory for CV data from MARWIS and other state-maintained sources.
- Explore and evaluate opportunities for business process improvements in preparation for CV data and technologies.

#6: Strategic Telecommunications Plan & Fiber Map

- CHART's Communication Division will wrap-up the Strategic Telecommunications Plan and circulate to the MDOT SHA CAV Working Group for information and comment.
- Work closely with MDOT and DOIT to develop a map inventory of locations with fiber across the State.