

CONNECTED AND AUTOMATED VEHICLE 2019 ACCOMPLISHMENTS & THE ROAD AHEAD



MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

MARCH 2020

MESSAGE FROM THE ACTING ADMINISTRATOR/DEPUTY ADMINISTRATOR FOR OPERATIONS, CHIEF ENGINEER



The future of transportation is here – while we’re not all flying around like the Jetsons quite yet, all over the nation, progress is being made to integrate innovation and technology into safer, more reliable, and more equitable mobility options. Here in Maryland, we are making great strides towards being able to offer our customers a roadway network and technology/communications infrastructure than can support the use of Connected and Automated Vehicles (CAVs.)

In the two years since the Maryland Department of Transportation State Highway Administration (MDOT SHA) released our Strategic Action Plan for CAVs, we have seen a tremendous amount of activity and progress towards realizing our goals and making the future of transportation a reality in Maryland. After meeting many of the goals set for the CAV Program in 2017 and accomplishing a number of key items throughout 2018, we took the time to evaluate where we were and where we needed/wanted to be in the future, and developed six objectives (aligned with the original goals) to focus on in 2019 and drive the success of the program.

I am happy to report that the CAV Program, with support from MDOT SHA leadership and the CAV working group, has continued to meet their goals and objectives for 2019, all while continuing to evaluate, reassess, and prioritize their status and activities for continuous improvement in 2020 and beyond. This willingness to be objective and seek critical feedback about the state of CAV in Maryland continues to position this initiative to become more of a reality in the near future.

No matter what the future of transportation ends up looking like, Maryland will continue to be a leader in advancing our CAV program, which must continue to be supported and funded, carried out by passionate agency and industry staff, and embraced by our customers. By working together and continuing to make progress, there are no limits to what MDOT SHA’s CAV Program can do.

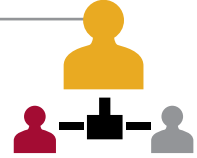
Tim Smith

Acting Administrator/Deputy Administrator for Operations, Chief Engineer

In last year's Accomplishments document, MDOT SHA listed 6 priorities it wanted to focus on in 2019. Throughout 2019, the agency carried out several activities that helped further those priorities. The MDOT SHA CAV Working Group evaluated how the program had performed for each 2019 priority. Below are highlights from some of the key activities the agency carried out, and results from the survey:

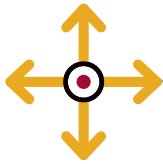
ORGANIZATIONAL MANAGEMENT OF CAV

CAV efforts are now led by a new Connected and Automated Transportation Systems (CATS) Division within the Office of CHART and ITS Deployment.



OBJECTIVE #1

SUPPORT CAV DEPLOYMENT EFFORTS



The CAV Technology Deployment Dashboard was updated to include several MDOT SHA ITS devices.

Received a \$40,000 State Transportation Innovation Council (STIC) Grant to deploy Connected Vehicle Technology for pedestrian safety.

Developed a Data Governance document on the creation and management of MAP messages.



"Seem like important tasks were completed."

OBJECTIVE #2

DEVELOP TECHNOLOGY-BASED PROJECT LIST



Developed a scope for a Truck Parking and Information Management System pilot project on the I-95 corridor.

"Truck parking implementation and tech needed for a long time plus need a wider map of 'pilots'."



OBJECTIVE #3

DEVELOP AND MAINTAIN CAV EDUCATIONAL MATERIALS



Held the first ever agency-wide webinar Lunch and Learn on CAV, with over 120 attendees.

Released a CAV 101 Training Application for MDOT SHA employees

"I thought this is where MDOT SHA really shined this year- definitely exceeded expectations."



OBJECTIVE #4
SUSTAIN NATIONAL & REGIONAL INVOLVEMENT



Participated in the following organizational events:

- ✓ Connected Vehicle Pooled Fund Study (CVPFS)
- ✓ ITS America V2X/AV/Cybersecurity/Smart Infra/MOD alliance
- ✓ AASHTO Committee on Transportation Systems Operations (CTSO)
- ✓ National Institute of Standards and Technology (NIST)
- ✓ I-95 Corridor Coalition Mid-Atlantic CAV Group



"National & Regional involvement helps us learn about how other jurisdictions are doing things & what challenges they face. Very important."

OBJECTIVE #5
PLANNING BACKGROUND EFFORTS



Performed a preliminary CAV VISSIM analysis of two major corridors in the state.

Participated in a Connected Vehicle Capability Maturity Workshop to help direct priorities for the coming years.

Performed a preliminary statewide sensitivity run of the impacts of CAVs on Vehicle Miles Traveled.



OBJECTIVE #6
STRATEGIC TELECOMMUNICATIONS PLAN AND FIBER MAP



No CAV efforts were completed in 2019, though significant resources were assigned to projects within the State.

"This is critical for us to be a leader in the CAV/CATS space."



OVERALL CAV PROGRAM EVALUATION



Given that the MDOT SHA CAV program is well into its fourth year, the Working Group was asked to take everything into consideration, rate the entire CAV program to date, and provide feedback and recommendations.

Overall, the program was ranked:

BELOW EXPECTATIONS

0%

MET EXPECTATIONS

61%

EXCEEDED EXPECTATIONS

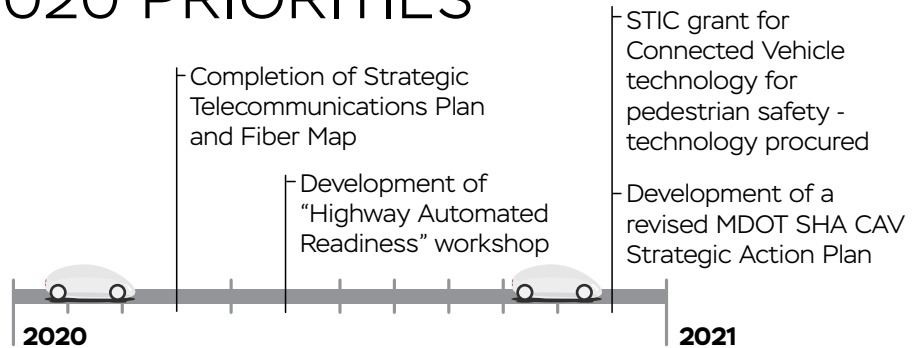
39%





THE ROAD AHEAD

2020 PRIORITIES



SUPPORT CAV DEPLOYMENT EFFORTS

- ▶ Deploy the 1st pedestrian DSRC/C-V2X technology project in Maryland and create the standard operating procedure for future MDOT SHA DSRC/C-V2X deployments
- ▶ Develop Technology-based Project List

INTERNAL AND EXTERNAL EDUCATION OF CAV

Some educational efforts that will be carried out in 2020 include:

- ▶ Transportation and Civil Engineering (TRAC) in-school workshops
- ▶ Participation in Science, Technology, Engineering, and Math (STEM) events for students
- ▶ A second Lunch and Learn for agency staff

SUSTAIN NATIONAL & REGIONAL INVOLVEMENT

- ▶ Continued participation in National Committees
- ▶ Continued participation and support of the Maryland Statewide CAV Working Group

PLANNING EFFORTS

- ▶ Development of "Highway Automated Readiness" workshop
- ▶ Completion of the Strategic Telecommunications Plan and Fiber Map
- ▶ Development of a Revised MDOT SHA CAV Strategic Action Plan

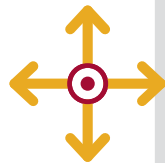


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INTRODUCTION

In December 2017, the Maryland Department of Transportation State Highway Administration (MDOT SHA) released a Strategic Action Plan for Connected and Automated Vehicles (CAV) to prepare its infrastructure, policy, and operations for the future landscape of transportation. The 2017 MDOT SHA CAV Strategic Action Plan defined several strategy statements that helped drive CAV initiatives in the 2018 calendar year. It included the following five goals:



GOAL 1 ▶

Make Maryland an attractive partner for CAV development, testing, and production; Maryland is “open for business.”



GOAL 2 ▶

Begin deploying CAV technology to gain experience through pilot projects, and work with partners to engage in national efforts.



GOAL 3 ▶

Establish foundational systems to support future CAV deployment – data management, telecommunications, and a robust policy program to enable sustained deployment activity.




GOAL 4 ▶

Enable CAV benefits for customers—identify ways to add value for our customers today and in the near future during the transitional timeframe of CAV on our roadways.

GOAL 5 ▶



Look for opportunities to leverage CAV technologies to support existing business processes and objectives such as performance-based planning and provide operational benefits to support and enhance other business processes.

In early 2019, CAV initiatives were recorded in a  [“Year One: 2018 CAV Accomplishments & The Road Ahead”](#) report, available to all MDOT employees on our secure online SharePoint site, and simplified into a two-page pamphlet, available for public consumption (link [here](#)). The goal of reporting MDOT SHA’s CAV accomplishments was to track what worked and what caused stumbling blocks to the advancement of CAV within the agency. As a result of the report, MDOT SHA was able to see the “whole picture” of where CAV initiatives may need a bigger push or where realignment was necessary.

 *This is a link, check the digital copy for access to the resource*

This “fresh perspective” effort resulted in the development of six objectives to be completed by the end of 2019 that still met one or more of the original goals, while pausing the other objectives temporarily:

1. Support CAV Deployment Efforts (Goals 1 & 2)
2. Develop a Technology-based Project List (Goals 2 & 5)
3. Develop and Maintain CAV Educational Materials (Goal 4)
4. Sustain National & Regional Involvement (Goals 1 & 2)
5. Planning & Background Efforts (Goals 3 & 5)
6. Strategic Telecommunications Plan and Fiber Map (Goal 3)

The “Year Two: 2019 CAV Accomplishments & The Road Ahead” report aims to repeat the “fresh perspective” effort and walks through a high-level summary of 2019 accomplishments. It concludes with a discussion of 2020 CAV priorities for MDOT SHA.

Disclaimer: The statements recorded in this report are for the MDOT SHA CAV program only, which is internal to MDOT SHA. There is also a Maryland Statewide CAV Working Group that advances statewide CAV initiatives, but this report does not reflect statewide accomplishments from that group. For more information the Maryland Statewide CAV Working Group please visit [Ⓞ http://mdot.maryland.gov/MarylandCAV](http://mdot.maryland.gov/MarylandCAV).

Ⓞ *This is a link, check the digital copy for access to the resource*

STATUS OF 2019 PRIORITIES

CAV initiatives are strongly supported by both MDOT SHA agency leadership and the internal CAV Working Group, which is comprised of nearly 50 MDOT SHA staff, consultants, and partners. The internal group meets bi-monthly and is instrumental in aligning CAV initiatives across multiple offices for the cross collaboration of ideas and solutions. Each meeting agenda provides updates and requests recommendations for future actions to ensure eventual adoption by all MDOT SHA offices and districts. In fact, at the last bi-monthly meeting of the 2019 calendar year, the internal group was also asked to evaluate how the MDOT SHA CAV program had performed that year to solicit feedback about the progress of the CAV program. The group was asked to vote on each category of work the CAV Program had previously outlined in 2018 and grade the work performed in 2019.

Participants were given a laundry list of all accomplishments for each category to assist them in making their decision as to whether that category's goals were substandard, met, or exceeded. The feedback from the group on each of the six categories of work, which also helped prioritize the year ahead in 2020 are included below.

OBJECTIVE 1

SUPPORT CAV DEPLOYMENT EFFORTS

Goals 1 and 2: Make Maryland an attractive partner for CAV deployment and begin deploying CAV technology to gain experience through pilot projects.

Under this category, the 2019 goal was to include CAV-type solutions in targeted traditional project delivery processes. Highlights of the program efforts are detailed below.

The deployment of SPaT along the US 1 corridor in Howard County was a 2017 priority that was advanced in 2018, though not completed. Cobalt controllers with CAV modules were installed in 2018 at the 20 signal locations identified in 2017 and no significant progress made in 2019.

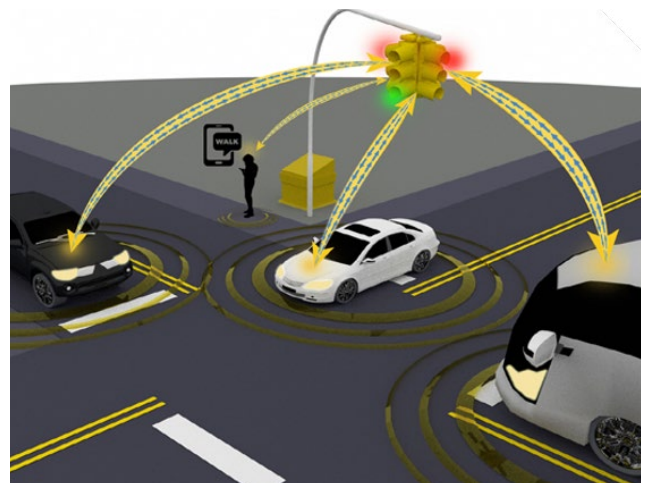


Figure 1

The SPaT challenge from the American Association of State Highway Transportation Officials (AASHTO), the Institute of Traffic Engineers (ITE), and ITS America (ITSA) is a “challenge to state and local public sector transportation infrastructure owners and operators to cooperate together to achieve deployment of Dedicated Short-Range Communication (DSRC) infrastructure with SPaT broadcasts in at least one corridor or network with approximately 20 signalized intersections in each of the 50 states by January 2020”.

In 2019, MDOT SHA applied for and received a \$40,000 State Transportation Innovation Council (STIC) Grant to deploy Connected Vehicle technology for pedestrian safety.

The STIC grant allows states to advance innovative transportation solutions that have not yet been tested in their state. The Connected & Automated Transportation Systems (CATS) Division team submitted and successfully received funding to deploy a pedestrian detection sensor combined with a Road Side Unit (RSU) that would send out messages to vehicles about pedestrians in the crosswalk at one intersection in Maryland. In concept, this deployment would be like a Pedestrian Rapid Flash Beacon (RFB), but instead of deploying bulky roadway infrastructure, a RSU would send messages directly to units within the vehicle if a pedestrian was detected in the crosswalk. By promoting in-vehicle messaging, CATS hopes to demonstrate to industry the need to accelerate in-vehicle messaging as it relates to vulnerable roadway users. It is expected the technology will be procured by end of 2020 and active within 12 months of procurement.

🌐 <https://www.fhwa.dot.gov/innovation/stic/guidance.cfm>

In 2018 and 2019, MDOT SHA developed a Data Governance document on the creation and management of intersection map messages, which was shared with our University of Maryland and Econolite partners.

This chapter document represents the first step towards ensuring MDOT SHA begins data governance and management of all CV related projects. More chapters are expected to be created as CV technology improves. See Appendix A for the full data governance chapter.

Additional efforts completed in 2019 include:

- ✓ Inserted connected vehicle technology strategies in MDOT SHA's TSMO project called "System 1" to address safety (e.g. end of queue warnings, curve speed warnings, and SPaT).
- ✓ Started exploring several strategies to create a single open data portal for MDOT SHA.
- ✓ Continued to maintain the statewide 🌐 [Maryland Locations for Enabling Testing Sites \(LETS\)](#) web mapping application.
- ✓ Continued to maintain the 🌐 [Connected and Automated Vehicle Technology Deployment Dashboard](#) .
- ✓ Collaboration with Econolite to support Connected Vehicles through a SPaT feed and signal digital infrastructure information.

🌐 *This is a link, check the digital copy for access to the resource*

BELOW EXPECTATIONS

10%

2019 ACCOMPLISHMENTS

"SHA should also take credit for funding UMD CATT research on CAV that will include having a vehicle available for testing v-i and i-v applications."

"Somewhat disappointed about the agency's efforts/progress on the SPAT deployment side of things."

"Signal Phase and Timing (SPaT) Challenge was a significant goal however given all other achievements - I expect meet goals is justified."

"Not CAV Programs "fault", but agency needs to 1. partner better, 2. find methods to move at good speed of technology."

"Seem like important tasks were completed."

MET EXPECTATIONS

70%

SUGGESTED PRIORITIES FOR 2020

"We need deployments to maintain interest."

"There's always more [that could be done]."

"Don't want to lag behind other states in the neighborhood."

"This process was starting and needs to be finished for the purposes of showing progress."

"Priorities should be revisited based on lessons learned and technology development."



EXCEEDED EXPECTATIONS

20%

OBJECTIVE 2

DEVELOP TECHNOLOGY-BASED PROJECT LIST

Goals 2 and 5: Begin deploying CAV technology to gain experience and look for Opportunities to leverage CAV technologies to support existing business processes to develop a library of potential CV technology projects that can be used for grant applications or TSMO projects.

Throughout the 2019 calendar year, only one project scope for a Truck Parking and Information Management System pilot project on the I-95 corridor was developed. This project was deferred to the Office of Planning and Preliminary Engineering as they pursue the [Statewide Truck Parking Study](#).

In parallel to the CAV program, the freight planning team at MDOT SHA initiated the development of a Concept of Operations for a Freight Information System in 2019. Both of these efforts will lead into exploration of available grant opportunities in 2020.

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BELOW EXPECTATIONS

47%

2019 ACCOMPLISHMENTS

"Expected more project development."

"I am not sure how many projects is a good number."

"Truck parking implementation and tech needed for a long time plus need a wider map of 'pilots'."

"Hope more can be done in 2020."

"Not sure on findings/studies."

MET EXPECTATIONS

53%

EXCEEDED EXPECTATIONS

0%

SUGGESTED PRIORITIES FOR 2020

"I think [we should keep it]; however, it's tough to think about "Technology Based Projects" without thinking first of what is the problem we are trying to solve with a particular technology."

"[Needed] To flush out next steps."

"Yes - More technology-based project opportunities exist and keeping the identification process going is critical."

"Maybe not? doesn't seem to be much interest."

OBJECTIVE 3

DEVELOP AND MAINTAIN CAV EDUCATIONAL MATERIALS

Goal 4: Enable CAV benefit for customers.

In 2019, MDOT SHA created and distributed CAV material to internal staff and begin conversations at the local jurisdiction level.

The Connected & Automated Transportation Systems (CATS) Division held the first ever

agency-wide webinar lunch and learn on CAV, with over 120 attendees.

In August 2019, the MDOT SHA CATS Division held an agency wide webinar for anyone to listen in on what CAV are and how they might impact our day to day jobs. The webinar was well attended and sparked a 30 minute Q&A session from attendees.

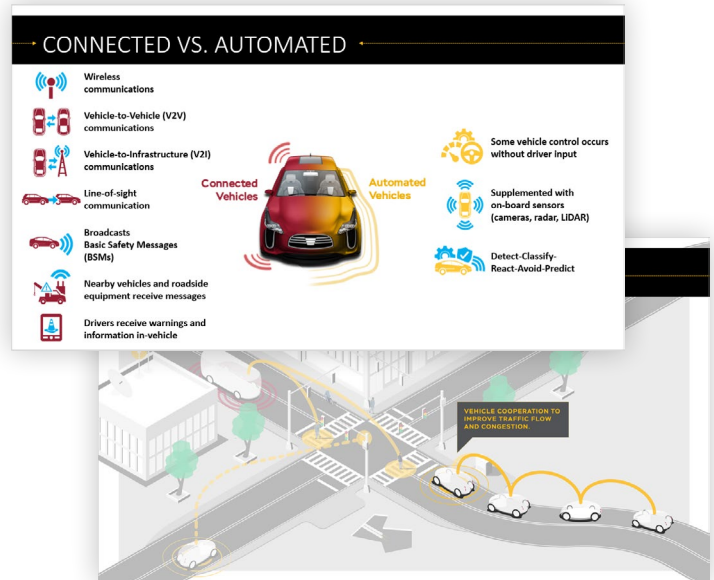


Figure 2

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Released a CAV 101 Training Application for MDOT SHA employees to increase awareness.

As part of the strategy to educate MDOT SHA staff, CATS created an interactive training module for basic CAV 101 information, following similar topics from the Lunch and Learn. The training was meant to allow anyone to learn on their own time and at their own pace. Currently, the training has been completed by 30 MDOT SHA staff, of which four are also part of the CAV Working Group. This means over 25 staff not related to the working group have also completed the training.

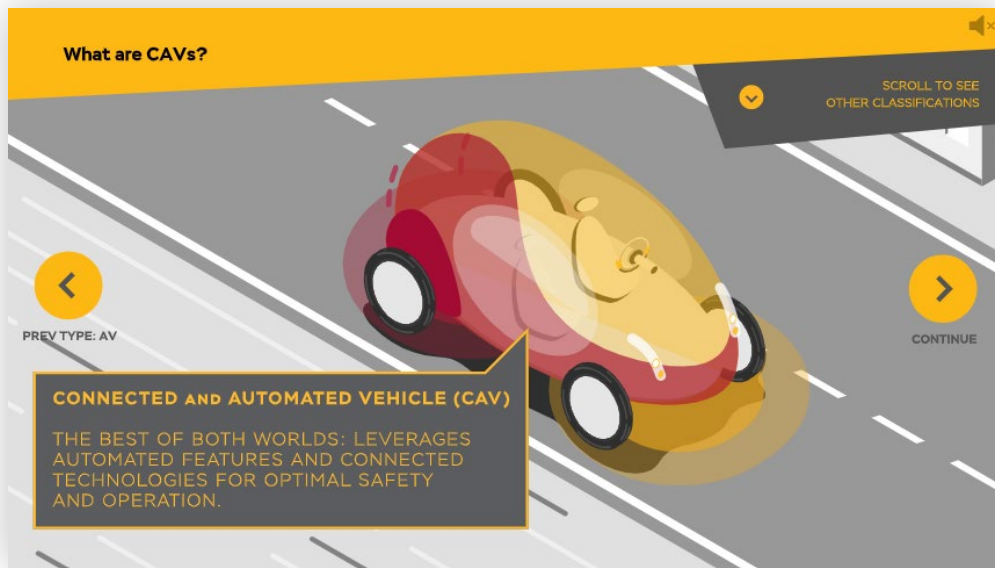


Figure 3

In addition to the above, the following educational efforts and events occurred in 2019:

- ✓ Developed a workshop agenda relating to CAV through AASHTO's TRAC educational program for middle and high school students, which is expected to be launched in Spring 2020. More details in the 2020 Priorities section of this report.
- ✓ The CAV program was featured in MDOT SHA's August issue of *All Lanes Open* newsletter and September's issue of [Momentum](#).
- ✓ Continued to maintain the [CAV Public Policy in the US Story Map](#) to track monthly legislative actions related to CAV across the country.
- ✓ Updated the [CAV Strategic Action Plan](#) public-facing webpage to include accomplishments from 2018 and priorities for 2019.
- ✓ Generated a weekly blog post featuring the latest CAV-related national reports and educational materials for all MDOT employees to subscribe to.
- ✓ Developed education flyers showcasing the MDOT SHA CAV program for the purpose of the ITS Maryland Annual Meeting and future conferences.

[This is a link, check the digital copy for access to the resource](#)

BELOW EXPECTATIONS

0%

2019 ACCOMPLISHMENTS

"CAV to the average person is somewhat of a "niche" technology or application. Pushing out educational materials in multiple media formats will be necessary for the foreseeable future."

"Exceeded Expectations - the team did an excellent job in this area."

"I thought this is where MDOT SHA really shined this year- definitely exceeded expectations."

SUGGESTED PRIORITIES FOR 2020

"Important to smooth out public acceptance of CAVs."

"Needs to be a continuous effort to engage all of MDOT SHA & mainstream CAV."

"Develop additional training materials for advanced and MD specific."

MET EXPECTATIONS

22%

"Necessary to get resources."

"Big percentage of 3,000 that still need info. Models can be used for others."

"Agency/personnel education and training is a must."

"Probably the most important priority outreach/ education is key to success of CAV program."

"Great job thus far being engaged and leaning-in to an agency that needs more positive folks to support innovation!"

"Is the goal of TRAC outreach to encourage CAV purchase? If so, should outreach be focused on potential vehicle buyers?"

"Yes, and enhanced. Using the CAV CMM, we should really aim to set new goals for education and employee engagement."



EXCEEDED EXPECTATIONS

78%

OBJECTIVE 4

SUSTAIN NATIONAL & REGIONAL INVOLVEMENT

Goals 1 and 2: To demonstrate MDOT SHA's involvement in CAV both locally and at the National level

This year MDOT SHA staff:

- ✓ Submitted a legislative topic for inclusion in 2020 session through the Office of Policy and Research.
- ✓ Assisted in the MDOT-wide submission of four Request for Comments (RFCs)/Advanced Notice of Proposed Rulemaking (ANRM) from the U.S. Federal Government.
- ✓ Joined and actively participated in national conversations with the:
 - Connected Vehicle Pooled Fund Study (CVPFS), where we participated in four summary meetings and one project level meeting this past year.

- o ITS America V2X/AV/Cybersecurity/Smart Infra/MOD alliance and Advocacy Trust groups, which meet weekly.
 - o AASHTO Committee on Transportation System Operations (CTSO) and National Highway Automation Task Force, which help make decisions to pursue CAV at the national level.
 - o CAV related National Institute of Standards and Technology (NIST) review panel.
 - o I-95 Corridor Coalition Mid-Atlantic CAV Group, which MDOT SHA helped create.
- ✓ Presented or attended 12 conferences or meetings in the 2019 calendar year, a significant portion of which were sponsored by national groups (e.g. ITS America, TRB, etc).
 - ✓ Attended approximately 30 MDOT coordination meetings with the core Maryland Statewide CAV Working Group representatives.

EVALUATION SURVEY FINDINGS

BELOW EXPECTATIONS

0%

2019 ACCOMPLISHMENTS

"Maintaining an "active" and possibly a leadership role locally and perhaps regionally will land the ability to steer favorable outcomes."

"Probably the strongest area currently."

SUGGESTED PRIORITIES FOR 2020

"National & Regional involvement helps us learn about how other jurisdictions are doing things & what challenges they face. Very important."

"Need for continuous engagement with the national & regional CAV efforts."

"We need to learn from other peers/agencies."

MET EXPECTATIONS

35%

"Learning more and coordinating within will remain high priorities."

"Next year is election year! not sure about priority."

"This is critical to continued success."

"MDOT needs to be up to speed on all the developments in this area."

"I would keep it as this is a fast changing expertise area. We should sustain it. If we are able to prioritize, perhaps the time commitment may be reduced and moved towards other goals."

EXCEEDED EXPECTATIONS

65%



OBJECTIVE 5

PLANNING BACKGROUND EFFORTS

Goals 3 and 5: Understand long term impact to MD and develop new interactive tools in support of planning. Build out CAV data inventory and explore opportunities for business process improvement.

During the 2019 calendar year, MDOT SHA performed multiple planning level efforts, as described below:

- ✓ The Office of Planning and Preliminary Engineering (OPPE) performed a preliminary CAV VISSIM analysis of the I-270 and I-495 corridors with various assumptions.
 - o Refinements would be necessary before results can be reported with reasonable support of findings.
- ✓ OPPE performed a preliminary statewide sensitivity run of the impacts of CAV on Vehicle Miles Traveled, and is expected to refine future modeling tools based on the outputs of an Optimistic Scenario and a Mid-Range Scenario. A preliminary report was created and is available to all MDOT staff (⚙️ [see SharePoint](#)).
- ✓ The Office of Traffic and Safety (OOTs) created the Automated Driving System (ADS) signage now being used in Maryland for ADS deployment pilots.
- ✓ A Connected Vehicle Capability Maturity Workshop occurred in November which will help direct priorities for the coming years. See report in Appendix B.
- ✓ Local jurisdiction outreach and coordination efforts were kicked off by MDOT SHA, and are now under the TSO umbrella for deployment. This effort will continue through 2020.
 - o The local jurisdiction survey is out.
- ✓ MDOT SHA behavioral survey effort idea was tentatively approved by TSO, expected through 2020 followed by an MDOT SHA regional demand model effort in 2021.
 - o Pending TSO final approval.
- ✓ Investigating the Work Zone Demonstration (WZDx) grant opportunity via the United States Department of Transportation (USDOT), to include connected vehicle data stream normalization.

EVALUATION SURVEY FINDINGS

BELOW EXPECTATIONS

0%

MET EXPECTATIONS

63%

EXCEEDED EXPECTATIONS

37%

⚙️ This is a link for internal users, check the digital copy for access to the resource

OBJECTIVE 6

STRATEGIC TELECOMMUNICATIONS PLAN AND FIBER MAP

Goal 3: Establish foundational systems to support future CAV deployment. The specific action items in 2019 for this objective were to complete strategic telecommunications plan and circulate for comment, and work closely with MDOT and DOIT to develop a map inventory of locations with fiber across the State.

In 2019, a Telecommunications Deployment Strategy task was initiated to prepare for technology deployments, with an expected deliverable date of Spring 2020. No other efforts were completed in 2019 relating to CAV, though significant resources were assigned to significant projects within the State.

EVALUATION SURVEY FINDINGS

BELOW EXPECTATIONS

17%

2019 ACCOMPLISHMENTS

"Major progress compared to past. Plans support the future need."

"Met Expectations - Need to meet established deadline (Spring 2020). The agency should be further along."

"Would have liked to see this further along."

MET EXPECTATIONS

83%

SUGGESTED PRIORITIES FOR 2020

"This is critical for us to be a leader in the CAV/ CATS space."

"[CAV] Will not work without robust communications system."

"[CAV] Will continue to drive the telecom needs."

"Strategic plan is essential for any CAV efforts moving forward. Executive leadership has to be reminded daily about this."

"CAV will need the IT of Fiber Optics for utilization. Need a plan to procure our own conduit and fiber paths and connections."

EXCEEDED EXPECTATIONS

0%



BELOW EXPECTATIONS

0%

MET EXPECTATIONS

61%

EXCEEDED EXPECTATIONS

39%

61% of surveyed staff ranked the 2019 CAV program as “Meeting Expectations”; the other two categories were “Exceeded Expectations” at 39% and “Below Expectations” at 0%. There was a total of 1 academia, 1 Metropolitan Planning Organization (MPO), and 17 MDOT SHA staff responders. Word-for-word recommendations and overall thoughts from responders for the 2020 CAV program are provided below.

SUGGESTIONS FOR 2020 PROGRAM PRIORITIES

"Continued emphasis / focus on pilot deployment efforts."

"Identify potential pilot projects in cooperation with local governments."

"Keep pushing forward & stay involved as much as possible."

"Are there other pilots that would provide short term benefits and provide additional test cases?"

"CATS readiness from policy, process & technology standpoint (i.e. how ready are we for automation?)."

"A low speed shuttle from a senior home to a medical facility could be both useful to riders and present a defined odd."

"Scoping out CATS projects/CATS elements in MDOT SHA projects."

"Continue involvement with CAV communities of practice and continue public awareness campaigns."

"Investment in big data, data governance & modeling/analytics for CATS."

"MDOT needs buy-in from Maryland General Assembly- many changes in leadership could create good opportunities."

"In 2020 there needs to be some “live” accomplishments to drive further interest/ development."

"Coordination with all MDOT TBU's should be more widely encouraged."

"Pilot projects and deployments are falling behind, but opportunities exist for improvement."

"Procure contracts to deploy MDOT SHA's own fiber optic cable installation."

"Identify projects that are low hanging."

ADDITIONAL THOUGHTS ON MDOT SHA'S CAV PROGRAM

"The creation of a CAV position was a very positive step by MDOT SHA."

"Nothing specific, it's just good to see us involved."

"Telecommunications Plan ITS Assets and Asset Management CAV Readiness Assessment Make progress through the CAV CMM framework."

"Working group meetings and scheduled times have proven to be a success at both the MDOT SHA and MDOT levels."

"Need more lunch & learn trainings to stay up to date on current MDOT CAV initiatives."

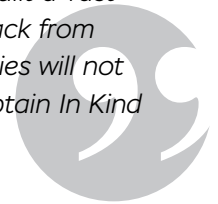
"[Need more] Newsletter and events."

"Have a consultant explain what/how CAV applies to each major MDOT SHA division and include that in training and education."

"CAV is the future of transportation. As the 1920's creating a network of roads was critical, in the 2020's setting up an infrastructure for CAV compatibility will likely be equally as important. This is how seriously MDOT SHA should value CAV efforts."

"Continue on education, outreach, and strategic efforts. With those efforts, we may be maturing to implementation efforts. We need to educate other parts of MDOT SHA on how their work may change as a result or learn about their ideas."

"Do not assume fiber will easily cone through Resource Sharing laws/requirements for telecom and IT companies. While we have built a vast network on Interstates, the push back from Legislative officers for said companies will not be an easy path for the State to obtain In Kind services for use of the ROW."



2020 PRIORITIES

In 2020, MDOT SHA intends to build on the momentum of the past two years, and will actively pursue four of the previously identified 2019 priorities. All the priorities remain based on feedback from the internal working group, as described in the previous pages; however, two were folded into more appropriate categories:

- “Develop Technology-based Project List” was folded into “Support CAV Deployment Efforts”, and
- “Strategic Telecommunications Plan and Fiber Map” was folded into “CATS Division Efforts”.

Under each of these categories, new initiatives have been outlined based on the feedback summarized in the previous pages. It is expected each of these efforts will be completed or close to completion before the end of 2020.

SUPPORT CAV DEPLOYMENT EFFORTS

Continuing a trend identified in the original 2017 Strategic Plan, the CAV program expects to pursue the following deployments efforts:

- Through the STIC grant, deploy the first pedestrian infrastructure to vehicle technology project in Maryland and create the standard operating procedure for future MDOT SHA deployments.
- Actively pursue Connected Vehicle (CV) big data capabilities and data governance (e.g. open portal) strategies to facilitate data exchanges.

INTERNAL AND EXTERNAL EDUCATION OF CAV

Pursuing the general direction of CAV Strategic Plan Goal 4, this initiative has become critical to successfully integrate CAV into MDOT SHA standard processes. In 2019, both internal staff and external stakeholders depending on MDOT SHA’s infrastructure requested more educational material, and collaboration opportunities. As such, the following efforts will be undertaken in 2020:

- TRAC in-school workshops (currently scheduled for 5 workshops in 2020)
- STEM events, including Engineer’s Week in February 2020
- Outreach strategy to support community vision for deployment of CAV
- ‘Workforce Impact’ Lunch and Learn Webinar
- Outreach to Divisions within MDOT SHA and any staff interested in learning more
- Additional educational material, as needed

SUSTAIN NATIONAL & REGIONAL INVOLVEMENT

Participation in National Committees

- Continued participation in AASTHO, CAT Coalition, ITS America and other national group meetings
- Involvement in MPO and local jurisdiction recurring meetings, to include CAV as a point of discussion
- Include others within MDOT SHA as the liaisons to other committees to begin integrating within normal day-to-day operations, examples of other committees or groups of interest:
 - NCUTCD
 - Pavement and materials

Statewide MDOT CAV Working Group

- Continued participation and support of the Maryland Statewide CAV Working Group meeting
- Continue to lead responses to Federal Register RFI, RFC, NPRM, etc. for MDOT
- Development of possible grant opportunities across multiple TBUs relating to CAV



Figure 4

CONNECTED & AUTOMATED TRANSPORTATION SYSTEMS (CATS) DIVISION EFFORTS

Development of Maryland’s Highway Automation Readiness

Integral to supporting an agency-wide integration of CAV is understanding our current readiness to incorporate CAV into our workflows. This effort will pull from national efforts to understand Maryland’s strengths and gaps when it comes to the deployment of CAV.

Development of an MDOT SHA Workforce Impact Assessment

The biggest takeaway from the Connected Vehicle Capability Maturity Model (CV CMM) in 2019 was that a significant portion of MDOT SHA staff are still unsure how CAV might affect their job responsibilities and how they should start considering CAV in their workflow. This effort falls under education; but is also being pulled out independently because this effort will determine the future direction of how the organization will support the CAV ecosystem.

Completion of the Strategic Telecommunications Plan and Fiber Map

This action item was identified in the original strategic plan and is critical to ensure the backbone for MDOT SHA’s communication is available for use by connected vehicle technologies. This effort is currently under way through a consultant contract, expected to be completed in late Spring 2020.

Outcomes from this task are expected to lay the foundation for the future of connectivity in Maryland, thus marrying well with the priority to develop the vision for a “Highway Automated Readiness” workshop.

Development of a Revised MDOT SHA CAV Strategic Action Plan

The 2017 CAV Strategic Action plan served as a launching pad for MDOT SHA, and was always considered a living document. As this plan moves into its third year, the agency hopes to provide a revised document by the end of the 2020 year with another 3-year outlook.

Development of a CAV Solutions “Toolbox” for MDOT SHA Planning Staff

As a result of the CV CMM workshop, this effort would develop a list of possible CAV-related solutions for staff throughout MDOT SHA to use during the planning phases of a project.

CLOSING THOUGHTS

The CAV program within MDOT SHA pursues innovation for the agency, but ultimately continues to serve the purpose of advancing more efficient solutions to help our communities travel safer, more efficiently, and in a more equitable manner.

Overall, MDOT SHA's CAV Program met or exceeded expectations in 2019. The following objectives were met successfully:

Objective 3 - Develop and Maintain CAV Educational Materials

Objective 4 - Sustain National and Regional Involvement

Objective 5 - Planning Background Efforts

And the following objectives will continue to be areas of focus and priorities in 2020:

Objective 1 - Support CAV Deployment Efforts

Objective 2 - Develop Technology-Based Project List

Objective 6 - Strategic Telecommunications Plan and Fiber Map

MDOT SHA continues to work together to make progress toward making our CAV Program a reality for the citizens of Maryland. We look forward to sharing our 2020 successes and beyond with you in the years to come, and offering our customers a roadway network and technology/communications infrastructure that can support the use of CAVs.

If you have any questions related to the MDOT SHA CAV Program or this report, please contact Ms. Carole Delion, Division Chief of the Connected & Automated Transportation Systems (CATS) Division, at cdelion@mdot.maryland.gov .

APPENDICES

APPENDIX A: MAP DATA GOVERNANCE CHAPTER



Data Governance Policy for MAP messages

version 0.1

October 1, 2019

Maryland Department of Transportation
State Highway Administration

Office of CHART & Intelligent Transportation Systems Development

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Overview

The purpose of this document is to provide guidance on the creation and maintenance of the MAP message and outlines standards to be used, conventions to be followed, message validation, and message maintenance.

MAP messages¹ are defined by the Society of Automotive Engineers (SAE) as follows:

The MapData (MAP) message is used to convey many types of geographic road information. At the current time its primary use is to convey one or more intersection lane geometry maps within a single message. The map message content includes such items as complex intersection descriptions, road segment descriptions, high speed curve outlines (used in curve safety messages), and segments of roadway (used in some safety applications). A given single MapData message may convey descriptions of one or more geographic areas or intersections. The contents of this message involve defining the details of indexing systems that are in turn used by other messages to relate additional information (for example, the signal phase and timing via the SPAT message) to events at specific geographic locations on the roadway.

This document aligns with the following recommendation from the MDOT SHA CAV Strategic Action Plan: **“undertake a comprehensive effort to define a CAV data governance plan for *efficient use of people, processes and technology, linking business objectives, programs and processes to data systems, services and products*”.**

Data Owners: MDOT SHA - Office of Planning and Preliminary Engineering

¹ Source: SAE Standard J2735_201603 - Dedicated Short Range Communications (DSRC) Message Set Dictionary

Guidelines

1) Base Coding Language

Policy

The base coding language for a MAP message is the SAE J2735_201603 standard, with the associated ASN.1 file/library for message creation.

Methodology

Per this standard, messages are structured as follows:

- The top level of complexity in the data structure standardization is called Messages (MSG)
- Data Frames (DF) are the next, more complex data structures to be standardized in this dense encoding
- The smallest divisions of information content to be standardized are called Data Elements (DE)

Standard Reference Number	Standard Name	Description
SAE J2735_201603	Dedicated Short Range Communications (DSRC) Message Set Dictionary™	This SAE Standard specifies a message set, and its data frames and data elements, specifically for use by applications intended to utilize the 5.9 GHz Dedicated Short Range Communications for Wireless Access in Vehicular Environments (DSRC/WAVE, referenced in this document simply as “DSRC”) communications systems. Although the scope of this Standard is focused on DSRC, this message set, and its data frames and data elements, have been designed, to the extent possible, to be of potential use for applications that may be deployed in conjunction with other wireless communications technologies as well. This Standard therefore specifies the definitive message structure and provides sufficient background information to allow readers to properly interpret the message definitions from the point of view of an application developer implementing the messages according to the DSRC Standards.
Link: https://mdotgov.sharepoint.com/:b:/s/DCP/IPPD/CAV/EdYHJhgFu71HkBR-eHPQSIUBHaW2mCmJm5dbm-NxTLFzHQ?e=760i4j		
SAE J2735ASN_201603	Dedicated Short Range Communications (DSRC) Message Set Dictionary™ ASN file	This Abstract Syntax Notation (ASN.1) File is the precise source code used for SAE International Standard J2735. As part of an international treaty, all US ITS standards are expressed in "ASN.1 syntax". ASN.1 Syntax is used to define the messages or "ASN specifications". Using the ASN.1 specification, a compiler tool produces the ASN library which will then be used to produce encodings (The J2735 message set uses UPER encoding). The library is a set of

		<p>many separate files that collectively implement the encoding and decoding of the standard. The library is then used by any application (along with the additional logic of that application) to manage the messages. The chosen ASN tool is used to produce a new copy of the library when changes are made, and it is then linked to the final application being developed. The ASN library manages many of the details associated with ASN syntax, allowing for subtle manipulation to make the best advantage of the encoding style.</p> <p>The J2735 Standard specifies a message set, and its data frames and data elements, specifically for use by applications intended to utilize the 5.9 GHz Dedicated Short Range Communications for Wireless Access in Vehicular Environments (DSRC/WAVE, referenced simply as "DSRC") communications systems. The ASN.1 integrates software for validation of telecommunications and networking. Although the scope of this Standard is focused on DSRC, this message set, and its data frames and data elements, have been designed, to the extent possible, to be of potential use for applications that may be deployed in conjunction with other wireless communications technologies as well. This Standard therefore specifies the definitive message structure and encoding and provides sufficient background information to allow readers to properly interpret the message definitions from the point of view of an application developer implementing the messages according to the DSRC Standards.</p>
<p>Link: https://www.sae.org/standards/content/j2735asn_201603/</p>		

2) Convention for Numbering MAP Geometry

Policy

For all MDOT SHA owned and operated intersections, all intersection lanes will be numbered and delineated for use in constructing the MAP message.

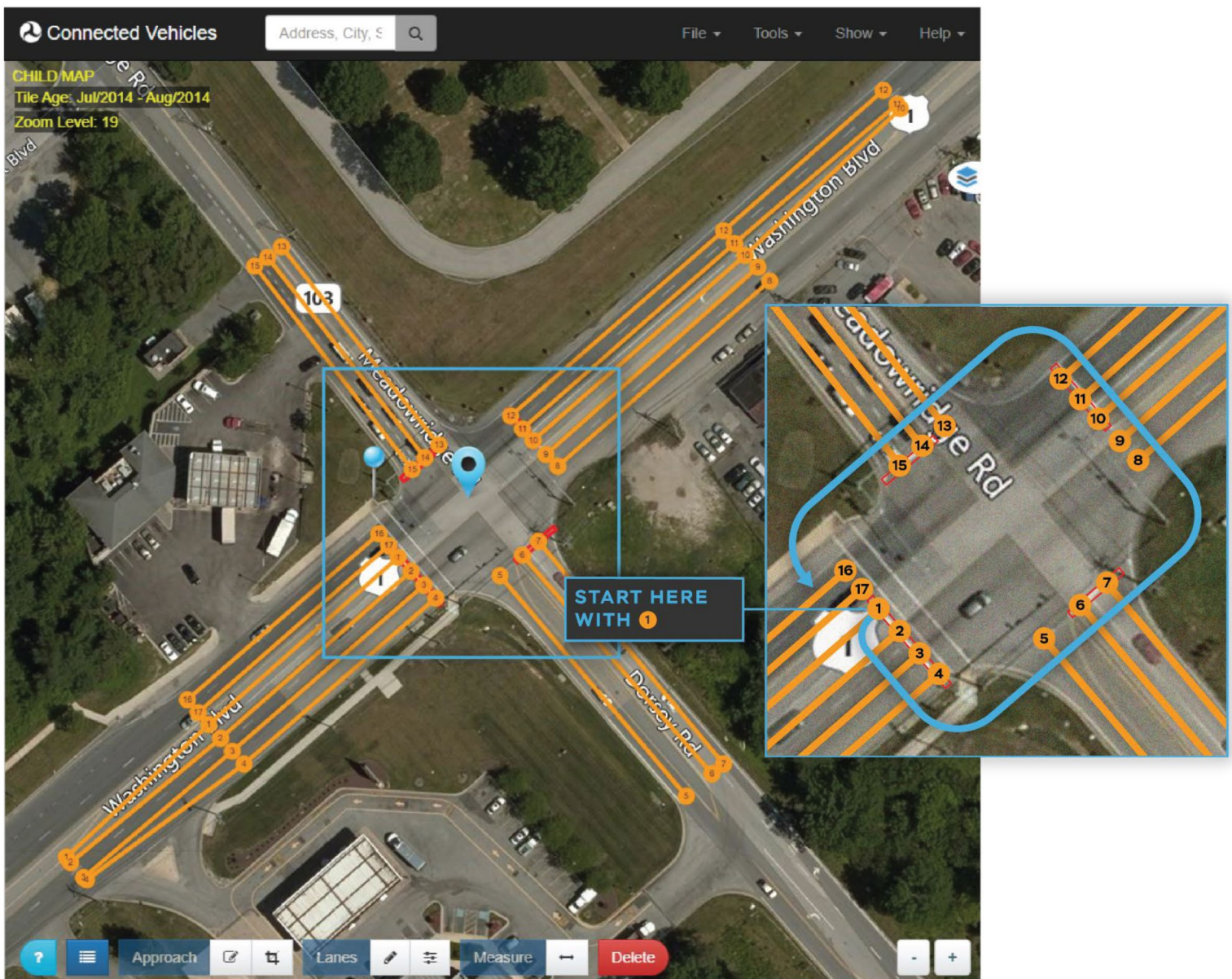
Methodology

Definition: major road is defined as the roadway with the higher functional classification. If both functional classifications are the same, then the major road is defined as the roadway with the higher AADT.

Based on the above definition:

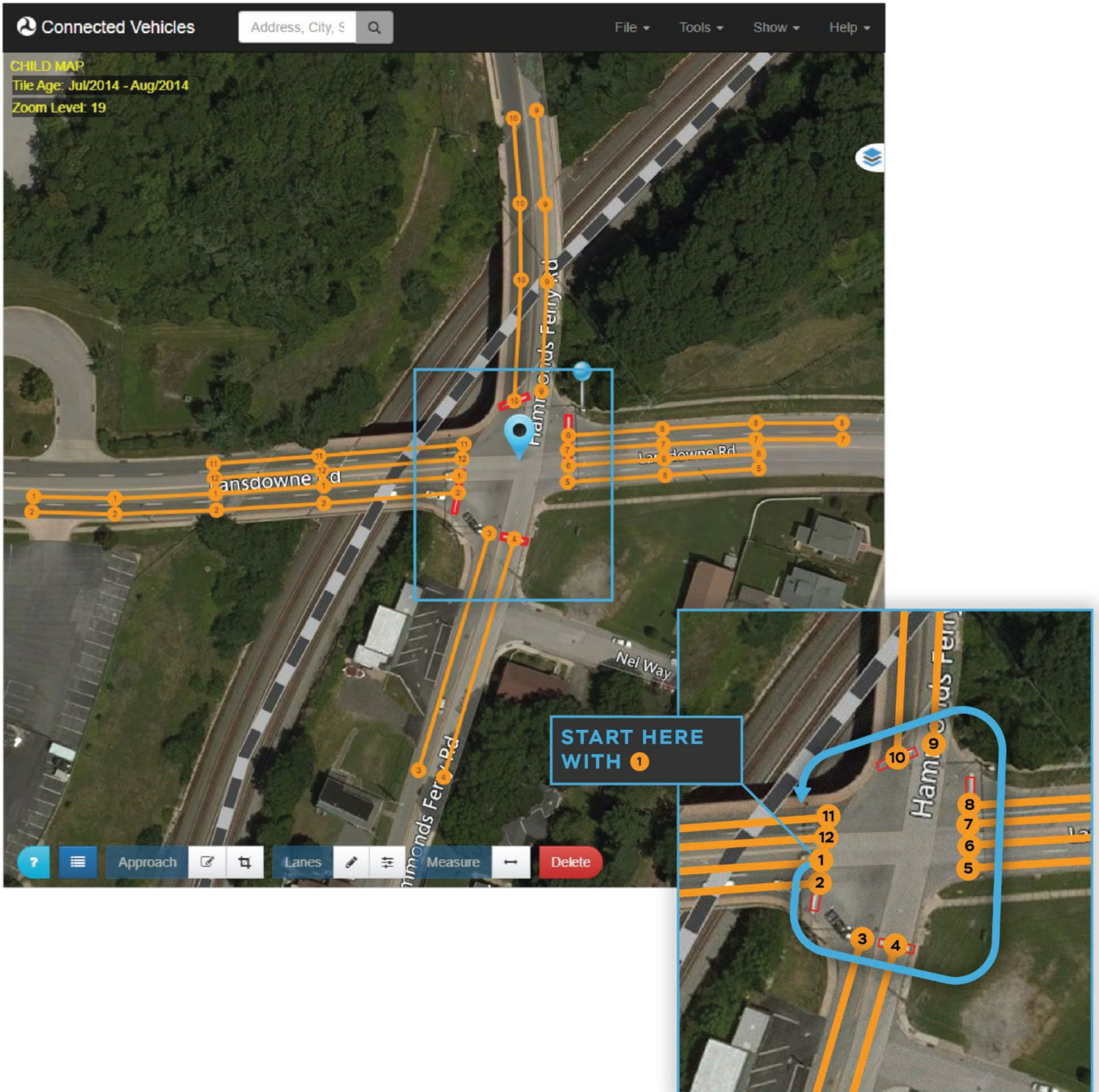
Where a major road runs north/south

- Step 1: Start with the Northbound, far left lane – this is marked as Lane 1.
- Step 2: Proceed around the intersection in a counterclockwise fashion sequentially numbering all lanes.



Where a major road runs east/west

- Step 1: Start with Eastbound, far left lane – this is marked as Lane 1.
- Step 2: Proceed around the intersection in a counterclockwise fashion sequentially numbering all lanes.



3) Associating MAP to SPaT

Policy

Linking MAP to signal phasing and timing (SPaT) occurs separately. The NEMA (National Electrical Manufacturing Association) phasing convention should be followed for establishing phase sequencing in the SPaT message. See SPaT Data Governance chapter.

The SPaT message standard stores the phase/lane relationship using the lane numbering established in the MAP message.

4) Validation of Encoded Message

Policy

MAP messages submitted for deployment should be submitted to the Office of Planning and Preliminary Engineering (OPPE) in the following formats:

- ASN.1 encoded text file (hexadecimal)
- XML text file (human readable)

Entity submitting MAP messages must also provide proof that the message has been validated and is well-formed by utilizing an alternate or third-party software to verify and decode well-formed messages like the MARBEN Free Online Automotive ASN.1 Messages Decoder (<http://www.marben-products.com/decoder-asn1-automotive/>). Alternative methods of message validation are welcome on a case by case basis with the approval of OPPE.

Final messages must be submitted to OPPE for review, approval, and storage in a data store. Upon successful validation/approval, the message can be deployed to the roadside equipment for transmission.

Data Maintenance

Owner/Point of Contact

Policy

The Office of Planning and Preliminary Engineering within MDOT SHA will be responsible for managing, updating, and distributing MAP messages as it relates to the mapping of an intersection.

MAP messages shall be stored and maintained in a dedicated Connected Vehicle (CV) data store. Storage requirements and architecture for this data store will need to be identified. Steps to be taken to identify a data storage mechanism:

- Work with the Office of Information Technology (OIT) to establish functional needs and requirements for data storage/maintenance of CV-related data

- Determine method for remotely deploying stored messages from the data store to the roadside equipment
- Engage the Office of CHART & Intelligent Transportation Systems Development and the Office of Traffic and Safety (OOTS) as primary stakeholders.

Annual Verification

Policy

MAP messages will be reviewed by OPPE on an annual basis to ensure all changes to the intersection geometry or attributes have been implemented and that any known future intersection geometry changes are scheduled in for verification.

Aerial imagery shall not be used for verification of the intersection geometry.

Methodology

Timely verification will be accomplished by creating a timeline of known future changes and when to verify they have been coded in.

Resources used for this verification include field visits, contacting project managers, and on-demand drone flights from the Office of Information Technology.

Intersection Modifications

Policy

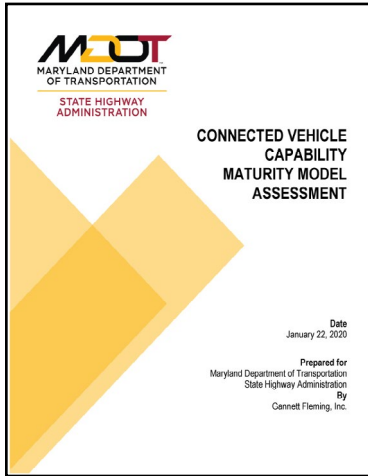
All Offices within MDOT SHA will track changes made to intersection geometry and submit “change orders” to OPPE for update in the CV data storage database.

Methodology

In order to assess planned future changes to existing intersections where MAP messages are deployed, all Offices within MDOT SHA will submit a list of those MAP messaged intersections to OPPE in order to determine if any proposed changes are designated for construction within the next 2 years. MAP messages will need to be modified and re-deployed to those intersection RSUs where construction will take place.

APPENDIX B:

CONNECTED VEHICLE CAPABILITY MATURITY MODEL WORKSHOP REPORT



APPENDIX C: RESOURCES

NATIONAL

Connected Vehicle Videos (USDOT ITS JPO)

🌐 <https://www.its.dot.gov/communications/video.htm>

Connected Vehicle Pilot Deployment Program (USDOT ITS JPO)

🌐 <https://www.its.dot.gov/pilots/>

How Connected Vehicles Work Factsheet (USDOT ITS JPO)

🌐 https://www.its.dot.gov/factsheets/pdf/JPO_HowCVWork.pdf

National Highway Traffic Safety Administration (NHTSA) Technology & Innovation

🌐 <https://www.nhtsa.gov/technology-innovation>

NHTSA Levels of Automation

🌐 <https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety>

STATE OF MARYLAND

Statewide MDOT CAV initiatives

🌐 <http://www.mva.maryland.gov/safety/MarylandCAV/index.htm>

Connected and Automated Vehicle Public Policy across the US

🌐 <https://maryland.maps.arcgis.com/apps/MapTour/index.html?appid=92d646772ec743d7852ba001e0559a3f>

MDOT State Highway Administration CAV Strategic Action Plan

🌐 <https://maryland.maps.arcgis.com/apps/Cascade/index.html?appid=44c92899dc5249038f6c22ba29ac473b>

MDOT SHA CAV SharePoint Site

⚙️ <https://mdotgov.sharepoint.com/sites/DCP/IPPD/CAV/SitePages/Home.aspx>

Maryland Locations to Enable Testing Sites (LETS) for CAV

🌐 <https://maryland.maps.arcgis.com/apps/opsdashboard/index.html#/176b1bd37c3541d9b80398e7fa01f720>

🌐 *This is a link, check the digital copy for access to the resource*

⚙️ *This is an internal link, check the digital copy for access to the resource*