Northeast Autonomous and Connected Vehicle Summit Report

Prepared by:
Eric Jackson, Ph.D.
Tara Simler
Peter Calcaterra
Eric Runowicz

Report Number: CT-2311-F-18-6

Final Report

October 2, 2018

SPR-2311

Connecticut Transportation Safety Research Center
Connecticut Transportation Institute
School of Engineering
University of Connecticut

Submitted to:
Connecticut Department of Transportation
Bureau of Policy and Planning
Research Section

Colleen A. Kissane
Transportation Assistant Planning Director

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No.	2. Government Accession No.	3. Recipients Catalog No.
CT-2311-F-18-6	N/A	

4. Title and Subtitle	5. Report Date
Northeast Autonomous and Connected Vehicle Summit Report	October 2, 2018
	6. Performing Organization Code SPR-2311
7. Author(s) Eric Jackson, Ph.D., Tara Simler, Peter Calcaterra, Eric Runowicz	8. Performing Organization Report No.
9. Performing Organization Name and Address University of Connecticut Connecticut Transportation Institute 270 Middle Turnpike, U-5202 Storrs, CT 06269-5202	10. Work Unit No. (TRIS) N/A 11. Contract or Grant No. SPR-2311
12. Sponsoring Agency Name and Address Connecticut Department of Transportation 2800 Berlin Turnpike Newington, CT 06131-7546	13. Type of Report and Period Covered Final Report April 9, 2018 – September 30, 2018 14. Sponsoring Agency Code SPR-2311

15. Supplementary Notes
A study conducted in cooperation with the U.S. Department of Transportation and Federal Highway Administration

16. Abstract
The Northeast Autonomous and Connected Vehicle Summit was hosted by the Connecticut Department of Transportation and the Federal Highway Administration on June 12-13, 2018, at the Windsor Hartford Marriott. The event provided an open forum for stakeholders in the Northeast to network, share and discuss a wide range of topics related to the future of transportation and infrastructure. Through 30 different speakers, the summit provided direct access to both public and private experts who are currently developing, testing and studying various autonomous vehicle (AV), connected vehicle (CV) and connected and autonomous (CAV) technologies. The overall takeaways from the summit can be summarized as:

- Collaboration is key to successful and efficient deployment, testing and knowledge transfer. As a collective whole, much more can be learned and achieved than if each state is working independently. States should be active, engaged and willing to participate in collaborative efforts as the scope and impacts are too large to go it alone.
- Autonomous and connected vehicle needs must be integrated into a long-range plan, and technology capabilities are just one of many elements.
- States should not ignore education to foster user acceptance and integration of these technologies into our transportation culture.
- Highly specialized and focused discussions across state agencies and strategic partners must continue, and these partnerships need to be fostered.
- States should start by developing strategic plans with a clear vision for the future. Plans must be living documents that will need to be flexible, adaptable and updated on a regular basis.
- Technologies and policies are evolving too rapidly to create a document that is presumed to be static.

17. **Key Words**	18. Distribution Statement
Autonomous, Connected, DSRC, 5G, Summit, Northeast,	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA, 22161. This report is available online from National Transportation Library at http://ntl.bts.gov

19. Security Classif. (Of this report)	20. Security Classif.(Of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	32	N/A

DISCLAIMER

This report does not constitute a standard, specification or regulation. The contents of this report reflect the views of the authors, who are responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views of the Connecticut Department of Transportation or the Federal Highway Administration.

ACKNOWLEDGMENTS

This report was prepared by the University of Connecticut, in cooperation with the Connecticut Department of Transportation and the United States Department of Transportation, Federal Highway Administration. The opinions, findings and conclusions expressed in the publication are those of the authors and not necessarily those of the Connecticut Department of Transportation or the Federal Highway Administration. This publication is based upon publicly supported research and is copyrighted. It may be reproduced in part, or in full, but it is requested that there be customary crediting of the source.

The authors wish to acknowledge the support of personnel from the Federal Highway Administration, the Connecticut Department of Transportation and the University of Connecticut.

SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in	inches	25.4	millimeters	mm
ft	feet	0.305	meters	m
yd	yards	0.914	meters	m
mi	miles	1.61	kilometers	km
		AREA		
in^2	square inches	645.2	square millimeters	mm^2
ft^2	square feet	0.093	square meters	m^2
yd^2	square yard	0.836	square meters	m^2
ac	acres	0.405	hectares	ha
mi^2	square miles	2.59	square kilometers	km^2
		VOLUME		
fl oz	fluid ounces	29.57	milliliters	mL
gal	gallons	3.785	liters	L
ft^3	cubic feet	0.028	cubic meters	m^3
yd^3	cubic yards	0.765	cubic meters	m^3
		NOTE: volumes greater than 1000 L shall be shown in m^3		
		MASS		
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams (or "metric ton")	Mg (or "t")
		TEMPERATURE (exact degrees)		
°F	Fahrenheit	5 (F-32)/9 or (F-32)/1.8	Celsius	°C
		ILLUMINATION		
fc	foot-candles	10.76	lux	lx
fl	foot-Lamberts	3.426	candela/m^2	cd/m^2
		FORCE and PRESSURE or STRESS		
lbf	poundforce	4.45	newtons	N
lbf/in^2	poundforce per square inch	6.89	kilopascals	kPa

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.039	inches	in
m	meters	3.28	feet	ft
m	meters	1.09	yards	yd
km	kilometers	0.621	miles	mi
		AREA		
mm^2	square millimeters	0.0016	square inches	in^2
m^2	square meters	10.764	square feet	ft^2
m^2	square meters	1.195	square yards	yd^2
ha	hectares	2.47	acres	ac
km^2	square kilometers	0.386	square miles	mi^2
		VOLUME		
mL	milliliters	0.034	fluid ounces	fl oz
L	liters	0.264	gallons	gal
m^3	cubic meters	35.314	cubic feet	ft^3
m^3	cubic meters	1.307	cubic yards	yd^3
		MASS		
g	grams	0.035	ounces	oz
kg	kilograms	2.202	pounds	lb
Mg (or "t")	megagrams (or "metric ton")	1.103	short tons (2000 lb)	T
		TEMPERATURE (exact degrees)		
°C	Celsius	1.8C+32	Fahrenheit	°F
		ILLUMINATION		
lx	lux	0.0929	foot-candles	fc
cd/m^2	candela/m^2	0.2919	foot-Lamberts	fl
		FORCE and PRESSURE or STRESS		
N	newtons	0.225	poundforce	lbf
kPa	kilopascals	0.145	poundforce per square inch	lbf/in^2

*SI is the symbol for the International System of Units. Appropriate rounding should be made to comply with Section 4 of ASTM E380. (Revised March 2003)

TABLE OF CONTENTS

LIST OF FIGURES

Executive Summary

The Northeast Autonomous and Connected Vehicle Summit was hosted by the Connecticut Department of Transportation and the Federal Highway Administration on June 12-13, 2018 at the Windsor Hartford Marriott. The event provided an open forum for stakeholders in the Northeast to network, share and discuss a wide range of topics related to the future of transportation and infrastructure. Through 30 different speakers, the summit provided direct access to both public and private experts who are currently developing, testing and studying various autonomous vehicle (AV), connected vehicle (CV) and connected and autonomous (CAV) technologies. Autonomous vehicles are defined by the National Highway Traffic Safety Administration (NHTSA) as “those in which operation of the vehicle occurs without direct driver input to control the steering, acceleration and braking and are designed so that the driver is not expected to constantly monitor the roadway while operating in self-driving mode.” Connected vehicles are vehicles that use any number of different communication technologies to communicate with the driver, other cars on the road (vehicle-to-vehicle V2V) and roadside infrastructure (vehicle-to-infrastructure V2I), including location, speed and direction. Presentations at this summit covered safety and technology acceptance, impacts of the technology on transit and other areas, policy, planning, pilot programs, data and security, connectivity, issues that are unique to the Northeast and partnerships. Many of the pilot programs that were presented have made dramatic advancements since last year’s summit, and there are a growing number of pilot programs that are getting underway. Connecticut and Rhode Island each presented pilot programs that will kick off in 2018. Conference attendees were surveyed before and after the summit to gain a perspective of key topics, issues and action items that resulted from this summit. They are documented and reported as the findings and conclusions in this report.

Many of the survey respondents after the summit were surprised how fast this technology was moving and that there were pilot programs up and running. One respondent noted: “This was the first conference I've attended where the tone was ‘This is what we've done and this is what we learned’ rather than ‘This is what we're planning to do.’ ” The overall takeaways from the summit can be summarized as:

- Collaboration is key to successful and efficient deployment, testing and knowledge transfer. As a collective whole, much more can be learned and achieved than if each state is working independently. States should be active, engaged and willing to participate in collaborative efforts as the scope and impacts are too large to go it alone.
- Autonomous and connected vehicle needs must be integrated into a long-range plan, and technology capabilities are just one of many elements.
- States should not ignore education to foster user acceptance and integration of these technologies into our transportation culture.
- Highly specialized and focused discussions across state agencies and strategic partners must continue, and these partnerships need to be fostered.
- States should start by developing strategic plans with a clear vision for the future. Plans must be living documents that will need to be flexible, adaptable and updated on a regular basis.
- Technologies and policies are evolving too rapidly to create a document that is presumed to be static.

Chapter 1: Introduction and Background

Connected and autonomous vehicle (CAV) technologies have continued to rapidly evolve and are no longer viewed as purely science fiction. Vehicles being built and tested today incorporate advanced technologies that allow better and more direct interaction between vehicles and their environment, with and without human interaction. The advancement of these technologies helps to improve safety, increase transportation efficiency, and reduce human input for navigation. In the years ahead, connected and autonomous vehicle technologies are expected to bring about major changes to the transportation system and travel behavior, which, by extension, could impact future transportation infrastructure needs for states. The range of these impacts will likely be broad, including both direct changes to road use and capacity as well as implications for transportation safety, transit use, and investment in infrastructure projects.

With the rapid development of these modern technologies comes a variety of technical, logistical, and societal impacts and challenges. To foster discussions on the future of this technology, the University of Connecticut (UConn), the Connecticut Department of Transportation (CTDOT) and the United States Department of Transportation (USDOT) partnered to host the 2018 Northeast Autonomous and Connected Vehicle Summit (NACV Summit). This was the second annual summit hosted in Connecticut. Public and private sector stakeholders attending from the Northeast region met to exchange ideas and learn about pilot programs from across the country. Stakeholders included federal, state and local governmental officials, original equipment manufacturers (OEMs), technology companies, special interest groups and associations, consultants and connected and autonomous vehicle-related vendors. Furthermore, the summit provided an opportunity for researchers to learn about current state-of-the-art connected and autonomous vehicle technologies and where additional policy and research is needed.

Chapter 2: Research Approach

The NACV Summit was hosted at the Windsor Hartford Marriott on June 12-13, 2018. The agenda for this event can be found in Appendix A. The summit provided an open forum for stakeholders in Connecticut and the Northeast region to discuss a wide range of topics related to the future of transportation and infrastructure by providing direct access to those currently developing and testing this technology. The original goal of this summit was to meet the following objectives:

1. Provide federal, state, and local officials the opportunity to learn about the latest advancements in the connected and autonomous vehicle industry.

2. Provide a forum for discussions between the various stakeholders in the region to plan and unite on transportation policies, programs and economic opportunities that will come as part of the further advancement of connected and autonomous vehicle technologies.

3. Allow investors and inventors the opportunity to meet and explore future opportunities.

4. Advance the Northeast as a leader in connected and autonomous vehicle research and innovation.

The Connecticut Department of Transportation (CTDOT) and the University of Connecticut Transportation Safety Research Center (CTSRC) partnered to form a Planning Committee (Committee). After securing a venue, a pre-event survey (Appendix B) was sent to last year's Autonomous Vehicle Summit attendees so that an agenda could be formulated. The survey asked the following questions:

1. What topics would you like to see covered?
2. Would you prefer a one-day or two-day conference?
3. Would you prefer a large session format, or breakout groups, or a combination of both?
4. Would you be interested in presenting, or do you have someone you would recommend to present?

Of the limited responses received, the majority indicated that a one-day conference was preferable, and a combination of large session and breakouts groups was preferred. The topics of interest included infrastructure, emerging technologies, Autonomous Vehicle (AV) planning, testing and pilot studies, data and security, advances since last year's summit, OEM technology and policy issues.

In alignment with the summit goals, the Committee also targeted specific participants to ensure a successful event. It was determined that both public and private sector stakeholder representation was necessary to ensure a wide breadth of information. The Committee looked for individuals and groups with the expertise and perspectives on this ever-changing technology. The goal for the public sector was to have CTDOT, other CT agencies, towns, Councils of Government, other states, and USDOT representation. As for the private sector, the Committee looked to OEM and tech companies, special interest associations, consultants and vendors. Vendors present included Ocean State Signal, WSP, United Technologies Research Center, Seimens Ruggedcom, Live Traffic Data, Traffic Systems, Inc., and CDM. Each day of the summit allowed for ample networking opportunities with vendors that were set up during the continental breakfast as well as breaks, lunch and a reception offered at the conclusion of Day 1.

It was anticipated that bringing in a combination of public and private sector individuals would offer perspective, knowledge, experience and information on pilot projects across the Northeast and throughout the country. Each day, the registration was reviewed and approved by CTDOT. It was decided that there was enough information to have a 2-day summit focused on policy, technology, and infrastructure, with Day 1 dedicated to autonomous vehicles and Day 2 to connected vehicles.

To develop the agenda, the Committee began reaching out to potential presenters and panelists to ensure a variety of topics and expertise. As presenters and panelists were secured, we were able to round out the agenda with representation from around the county, not just the Northeast. The agenda was completed with 30 regional and national presenters (Appendix A). We had more than 200 public and private sector attendees from 22 different states. Throughout the planning process, the CTSRC website hosted a page dedicated to event updates, speaker information, the agenda and direct links to register and book a hotel room.

As a follow up to the summit, the Committee provided a survey (Appendix C) to solicit feedback from presenters and attendees. The Committee plans to use the feedback received to begin planning next year's summit. Details and results of the survey are discussed in the Conclusion section of this report.

Figure 1: Presenter Affiliations for the 2018 NACV Summit

Chapter 3: Findings and Applications

Over the two-day summit, there were several recurring topics that both the presentations and questions from the audience tended to focus around. The key focus areas from the summit are summarized below. This document is not intended to be an exhaustive review of autonomous or connected vehicle technologies, but simply a review of the topics presented at the conference and the key takeaways that emerged from this event.

Safety and Technology Acceptance

Recent news stories and crashes involving CAVs have made some question the future of autonomous driving. Each of these events has an impact on public perception and one's own future adoption of this technology. In an effort to gage public acceptance and future adoption of the technology, the American Automobile Association (AAA) has been conducting an autonomous vehicle surveys on a continuous basis. Recent survey results show the impact that a single high-profile crash might have on public perception of this new technology (AAA 2018a, AAA, 2018b). In December 2017, 63% of U.S. drivers reported that they would be afraid to ride in a fully self-driving vehicle. This was down from 78%, which was reported earlier in 2017. This indicated that consumers were becoming more comfortable with the technology. However, on March 19, 2018, a pedestrian was struck and killed by an autonomous vehicle being tested by Uber. AAA's research on this topic has shown that the greatest fear and primary concern reported by 72% of those surveyed was "safety and reliability." Figure 2 is a graphic, presented by Jennifer Ryan, Director of State Relations for AAA, which shows their survey results a month after the Uber crash. This single event raised public fear of riding in autonomous vehicles to 2016 levels. Following up on the Uber crash, the National Transportation Safety Board (NTSB) was able to present details about their on-going investigation into this fatality.

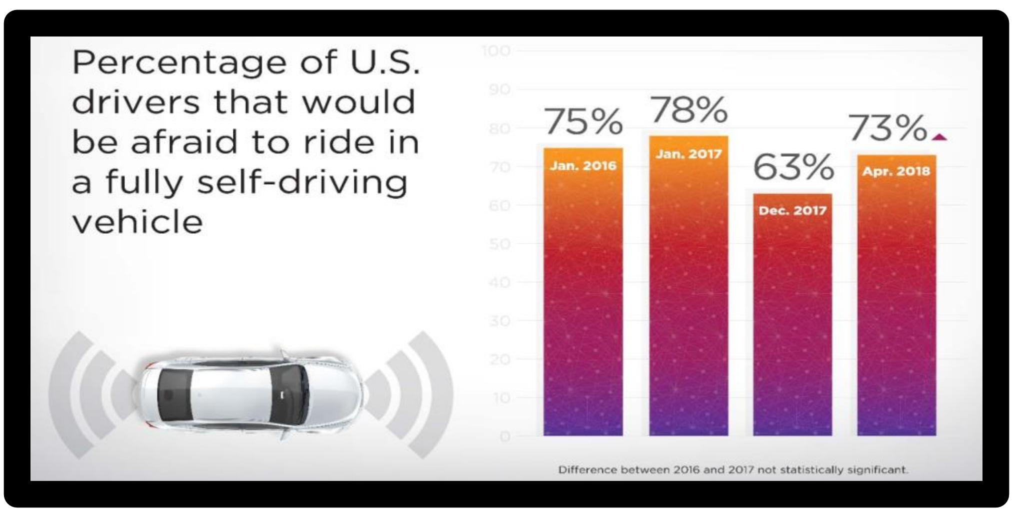

Figure 2: AAA Study on Fear of Self-Driving Vehicles

According to the NTSB's preliminary report on the incident, Uber's self-driving car was able to detect the pedestrian as she was attempting to cross the street (NTSB, 2018). The car's radar and LIDAR, which stands for Light Detection and Ranging, sensors detected an unknown object about six seconds before the crash, but it misclassified the pedestrian—first as an unknown object; then, as a vehicle; then, finally, as a bicycle. The vehicle's onboard systems tried to initiate emergency braking maneuvers 1.3 seconds before impact, but the vehicle's factory-equipped automated emergency braking system was deactivated during the install of self-driving technology to ensure less erratic vehicle behavior during testing.

When questioned, the NTSB reported that they will investigate most, if not all, CAV crashes for the foreseeable future. The Uber investigation is ongoing, but it appeared that recent changes to staffing requirements at Uber reduced the number of operators in the vehicle from two down to one. This required that one person monitor the vehicle systems and the roadway at the same time. After the NACV Summit, Tempe police released a 318-page report concerning this crash. In that document, the Tempe police determined that the operator of the Uber test vehicle was watching an episode of "The Voice" for nearly 42 minutes before the crash. Based on the crash timeline, this implies the driver started the video shortly after starting her test drive that evening. The Tempe police department has determined that this crash was entirely avoidable. The NTSB has yet to release their final report on this crash.

Impacts (Transit, Infrastructure, Etc.)

With the arrival of autonomous vehicles, comes daunting questions regarding transit and infrastructure. Impacts on public transit and mobility are less certain than many of the other topics mentioned above. Topics of concern include impacts on the transportation network, environment, travel habits and traffic volume. This uncertainty in market penetration and technology deployment leaves public agencies to question future investments. Should transit agencies be investing in a different type of fleet or service? Considering reduced demand and excessive cost of operation, who will pay? Mass transit contributes to communities economically and socially while reducing traffic congestion and providing mobility. A recent report, titled "Trends in Public Transportation Ridership: Implications for Federal Policy," by William J. Mallett (https://fas.org/sgp/crs/misc/R45144.pdf), showed a 7% decline nationally in ridership over the past decade. Similarly, the consulting firm, WSP, introduced the graphic in Figure 3 regarding transit ridership trends in 2017.

Figure 3: Transit Ridership Trends

According to WSP, as automated ride hailing services across the globe increase, fare prices will likely decrease, making these services even more affordable and attractive than public transit. If a rider can hail a ride and not have to wait for a bus, and then travel directly to their destination with few or no stops, all for a fare less than public transport, how do mass transit agencies compete? (See Figure 4.).

Figure 4: Shared Ride Cost Per Mile

In February 2018, key findings in a survey of ride hailing passengers, conducted by the Metropolitan Area Planning Council (MAPC) in Metro Boston, showed that 59% of all ride hailing trips added additional cars to the road system, and that 42% of passengers would have otherwise used public transit for their trips. Ridesharing is also attributed to a decrease in vehicle ownership and single occupancy vehicle trips, according to Transit Cooperative Research Program (TCRP) Research Report 195, titled "Broadening Understanding of the Interplay Between Public Transit, Shared Mobility, and Personal Automobiles," (http://nap.edu/24996). While there are many challenges facing public transit and infrastructure as technology advances, there are also opportunities for public transportation to learn from, build upon, and interface with this technology. There is still time for government to guide the implementation of automated vehicles, but there needs to be a clear vision of the potential impacts of this technology.

Policy

Public agencies are looking to government for guidance on automated and connected vehicles. In 2014, the American Association of Motor Vehicle Administrators (AAMVA) established an Autonomous Vehicle Working Group. The results of that working group were recently released. The report, based on the research, knowledge and experience of the working group from 2014-2018, is titled, "Jurisdictional Guidelines for the Safe Testing and Deployment of Highly Automated Vehicles," and can be found at: https://www.aamva.org/GuidelinesTestingDeploymentHAVs-May2018/ . AAMVA recognized the opportunity to provide guidance and direction on future policies impacted by CAVs. The report is broken down into four key topic areas:

- Administrative Considerations.
- Vehicle Credentialing Considerations.
- Driver Licensing Considerations.
- Law Enforcement Considerations.

AAMVA concludes that a successful path to autonomous vehicles must include an appropriate level of government oversight that is built on partnerships focused on stakeholder engagement by those involved in this rapidly developing technology.

States are beginning to create their own policies. Maryland has created a formal Expression of Interest (EOI) and permitting process for CAV pilot programs. The EOI is a starting point to alert the department and appropriate agencies of potential activity related to either autonomous or connected vehicle proposals. To date, they have received eleven EOIs. With respect to permitting of autonomous vehicles, Maryland has required that participants test on public roads, carry $5 million in insurance, self-certify (reporting requirements, vehicles, operators and plans) and obtain a unique permit for each vehicle. To date, only one entity has been issued two separate vehicle permits and is actively testing.

In Connecticut, the state has drafted and passed Public Act 17-69, Connecticut's first fully autonomous vehicle law. This was the result of an interagency working group working directly with the state legislature. Public Act 17-69 contains three major components, it:

- Defines key terms related to autonomous vehicles.
- Establishes a state pilot program to test fully autonomous vehicles in Connecticut.
- Creates a state legislative task force comprised of 15 appointed members from the executive and legislative branches of government to further study fully autonomous vehicles.

The state's legislative task force will further research and evaluate the regulatory, legislative and institutional challenges of deploying fully autonomous vehicles in Connecticut. The goals of this task are to:

- Evaluate various national standards and guidance documents on state responsibilities for regulating autonomous vehicles.
- Evaluate other states' proposed or enacted laws, legislation and regulations on autonomous vehicles.
- Recommend how the State of Connecticut should regulate fully autonomous vehicles through additional legislation or regulations.
- Evaluate the state pilot program for testing fully autonomous vehicles in Connecticut.

Planning for CAVs

It is expected that connected and automated technologies will bring profound changes to transportation. Proactive planning is necessary to implement these emerging technologies. There are countless issues to be considered while planning for the future, including financial, freight and land use. Parking and travel demand are two key areas that were covered at this summit. The Consulting firm, AECOM, reported that currently there are over 1 billion parking spaces in the United States, covering an area the size of Connecticut, where 30% of traffic is attributed to people searching for a parking space in a downtown area. There is also research showing that, as mobility options increases for groups that currently have challenges, and commuter trips become less about driving and multitasking is permissible, two dramatic shifts in land use may result: ridesharing services will reduce the need for personal automobile ownership and produce denser urban development while, at the same time, ease of driving and increases in mobility options may contribute to greater suburban sprawl. Mobilitics is AECOM's new scenario-planning tool that has been developed to estimate and plan for the potential impacts of connected and automated technologies. This planning tool attempts to incorporate the uncertainty of a variety of related technology deployments. Mobilitics is based on travel demand forecasting methodologies that attempt to incorporate uncertainty and volatility due to recent technologies into the scenario-based planning process. The system is designed to help public agencies and developers understand the long-range transportation and land use planning scenarios which will help inform policy, design and investment decisions. The key factors identified as part of the current planning process include:

- Percentage of Fleet.
- Changes in Vehicle Miles Traveled.
- Congestion Trends and Mitigation Potential.
- Pricing Impacts and Strategies with Respect to Financial Impacts with Fuel, Taxes, and Fees.

The I-95 Corridor Coalition is engaged in advancing CAV technology in the states that contain and are impacted by I-95. The I-95 corridor covers 21% of the nation's road miles and 35% of vehicle miles traveled, which covers only 10% of the national land mass but 37% of the nation's population. Figure 5 shows the member states self-reported (as of December 2017) level of CAV engagement. The Coalition also hosted a workshop for CAV technology on December 11-12, 2017. The outcomes of that workshop focused on strategies and planning for CAVs. The goals of the workshop were to share activities, identify challenges and solutions, and define implementation steps for members. A full report of this workshop can be found at www.i95coalition.org.

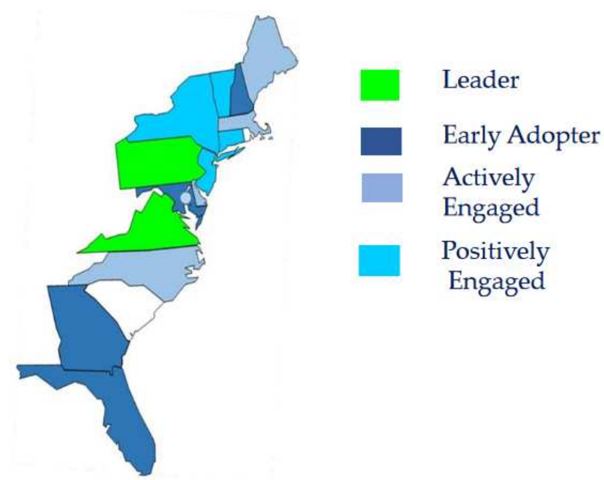

Figure 5: I-95 Corridor Coalition States

This workshop resulted in a guide that was drafted as a roadmap for a way forward. This path includes: 1) identifying leaders in your state or region; 2) creating a strategic vision; 3) starting a multidisciplinary stakeholder group with both public and private sector members; and, 4) being active and engage in testing and pilot projects. At the regional and corridor level, the I-95 Corridor Coalition recommends:

- Generating materials/toolkits to maintain a consistent message for full corridor connectivity.

- Bringing diverse stakeholders together across the region, including freight and law enforcement.
- Exploring rural highway examples.
- Investigating what is happening at ports.
- Exploring multi-state demonstrations (e.g. truck platooning).
- Identifying potential projects, even if funding is not available.

Maryland is in the process of developing a strategic plan and implementation plan, with the goal of being a national leader in CAV technology. These plans will help Maryland identify gaps in CAV policy. To date, MDOT has completed internal interviews with all the business units and held two webinars to gain external input and direction for future CAV activities. Maryland has created a multifaceted approach to planning for CAVs. This includes engagement with a variety of MDOT business units, implementation of strategic plans, establishment of the Maryland Connected & Automated Vehicle Working Group, and a process for letters of interest and permitting for testing. This working group was formed in late 2015 with varied stakeholders from state, local, county, private, technology and academic sectors. The working group meets quarterly and has hosted a variety of presentations over the last three years. MDOT is part of two FHWA pooled fund studies. The first, led by Oregon, is researching necessary adjustments to the Highway Capacity Manual based on CAV adoption. Nine states are involved, including CT and MD from the Northeast. The second is a vehicle infrastructure integration pooled fund study which would support large-scale connected transportation systems at the state and regional scale. This project is led by Virginia and includes 23 agencies, including CT, DE, MD, NJ, NY and PA from the Northeast.

Pilot Programs

Testing projects are becoming more prevalent throughout the United States, and planning tools using various scenarios can help create long range transportation plans. In 2017, Public Act 17-69 was passed in Connecticut to allow for the state's first testing pilot. This pilot program, titled "Connecticut's Fully Autonomous Vehicle Testing Pilot Program," (FAVTPP), was formed with the intent of having municipalities apply for controlled testing of autonomous vehicles. The goal is to have four different pilot areas meeting standards imposed by Connecticut's Office of Policy & Management.

Arizona city planners have proposed changes to zoning codes to allow better accommodation of ride-hailing and autonomous vehicles. California decided to move forward with driverless testing despite the recent Uber and Tesla crashes. Maryland issued its first testing permit in February to an OEM. Michigan recently opened its second facility for the testing of autonomous vehicles. In Nebraska, a bill (LB 989) passed that authorizes driverless vehicles to operate on public roads. The North Carolina Department of Transportation has recently awarded a grant to North Carolina State University to develop a driverless transit system. Texas Transit Authority is moving forward with allowing an autonomous shuttle to transport Texas Southern University students this fall.

In July 2017, Rhode Island established the Rhode Island Transportation Innovation Partnership (TRIP). The goals of TRIP are to achieve safer transportation, reduce congestion and fuel use, improve mobility, grow their economy and manage data and privacy. TRIP recently issued a request for proposals titled, "TRIP Autonomous Vehicle Mobility Challenge." This proposal identifies Providence's Woonasquatucket Corridor as a potential location to implement a pilot mobility service using AVs and Connected Vehicles (CVs) to connect downtown Providence with the Woonasquatucket Corridor. This location was chosen for a variety of reasons, one being that there is no existing public transit service in this area. The goal of this challenge is to further transform this section of roadway by bridging access to multimodal transportation options, as well as enhancing connectivity to other parts of the city.

On March 6, 2018, an EasyMile driverless autonomous shuttle bus was launched on the roads of San Ramon, California. This EasyMile shuttle bus made history by being the first to make use of recently approved regulations by testing on public roads. A key component to public transit agencies' vision should include partnerships with private sector OEMs.

Minnesota DOT is currently in the final phase of a pilot program which tested a Level 4 autonomous shuttle from EasyMile. The shuttle was tested in various weather conditions, as well as, while interacting with pedestrians, bicyclists and other vehicles. The testing determined a front stop distance of 5.3-6.6 ft from a pedestrian; a 6.5 ft stop distance from a bicycle; and, a 5.6 ft stop impact from a vehicle. The shuttle performed well in fresh snow and bare pavement, but not as well in blowing snow conditions. The physical structure of the car/sensors were not ideal for shedding leaves and snow because the sensors would get covered. (Information on state testing programs obtained from The Council of State Governments website – Sean Slone's blog.).

Minnesota is currently involved in several projects that align with their 50-year vision. MnDOT is currently developing a CAV strategic plan that will address how to design and operate roadways for this technology. This plan is expected to be completed by 2019. They have also established a working group per an executive order (18-04) that will establish guidelines and programs for the testing, development and deployment of connected and autonomous vehicles. A report is expected to be completed later this year.

The City of Boston launched an autonomous vehicle testing program to align with their zero fatalities vision. The City has partnered with Nutonomy, Optimus Ride, and Aptiv to test autonomous vehicles in the South Boston Waterfront, the South End and South Boston. The intent of this testing is to bring transportation safety, accessibility and reliability to its citizens as part of the larger GoBoston 2030 plan. The City foresees a future with vehicle technology testing in the city's unique environment, a business model that aligns with the goals of GoBoston 2030, research and testing with connected infrastructure and public engagement regarding mobility and workforce implications. More information may be found at: https://www.boston.gov/departments/new-urban-mechanics/autonomous-vehicles-bostons-approach.

With many states launching autonomous vehicle pilot programs, the City of Boston gave a list of best practices to be used: develop a clear mobility vision; balance stakeholder interests in approval process; create a tiered testing plan with achievement milestones; build trust between stakeholders; and, share updates on testing progress with residents regularly to build awareness."

Data and Security

As vehicles become more connected to each other and the infrastructure around them, they also become much more vulnerable to cyberattacks as does the data that is being shared. As we have seen in recent history, no personal computer, mobile device, corporate network or government agency is immune from cyberattacks or identity thieves. Data has become a new currency and connected vehicles will be sharing substantial amounts of it. This new data frontier has been branded the internet of roadways (IoR). The Colorado Department of Transportation (CDOT) is working with Panasonic to build the connected vehicle foundation that is at a scale which is hoped to solve many of the common traffic and safety problems. Once implemented, the 90-mile section of the Colorado I-70 corridor will generate approximately 82 million messages, i.e., approximately 23 Gb of data, every hour. The vast majority of messages will not be significant and routine. However, this generation of a "Big Data" repository will allow for research and analysis into viability of connected transportation technologies. Colorado is expanding a connected vehicle pilot program along approximately 90 miles of the I-70 Mountain Corridor between Golden and Vail.

In the New York City (NYC) connected vehicle pilot program, data security and physical security of the hardware were identified as potential performance measures. The approach taken in NYC was to collect all the relevant raw data for each event, and provide customized data for each event collected. Data were collected on the aftermarket in-vehicle devices on the taxi fleet, and then encrypted. Furthermore, the raw data collected was given a fixed lifetime to prevent future use of the data to identify individuals. Data collected were quickly binned and aggregated to obscure individual events or vehicles in the final dataset. Furthermore, precise time and date information was removed from the data to retain privacy.

Connectivity (SPaT, 5G and DSRC)

As described by the US DOT, "Dedicated Short-Range Communications (DSRC) is a two-way short-to-medium range wireless communications capability that permits very high data transmission critical in communications-based active safety applications. The U.S. DOT's commitment to DSRC for active safety communications contributes to safer driving. Vehicle safety applications that use vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications need secure, wireless interface dependability in extreme weather conditions, and short time delays; all of which are facilitated by DSRC."

The Signal Phase and Timing (SPaT) challenge is a program developed to encourage state and local public-sector transportation infrastructure owners and operators to deploy DSRC infrastructure with SPaT broadcasts. The goal is to achieve at least one coordinated corridor or network which would consist of approximately 20 signalized intersections in every state by January 2020. The importance of this challenge is to lay the groundwork for more advanced V2I deployment while promoting the technology to advance development and integration with new and emerging vehicle fleets. Toyota has already announced a commitment to include DSRC communications as standard features on vehicles starting in 2021. They are encouraging all automakers to adopt 5.9GHz DSRC for their vehicles. They believe this will accelerate the adoption of this technology. More than 32 states have already committed to deploying this technology and joining the SPaT challenge.

A SPaT-compliant message would provide the receiver of the transmission with the current intersection signal phases. Furthermore, the signal would relay both the current signalization of all lanes at the intersection and a detailed map of the intersection as well as alert the receiver with any active pre-emption or priority designations. All of the required protocols for the SPaT message are defined in the Society of Automotive Engineers (SAE) J2735.

In response to the SPaT challenge, Minnesota has started a project titled, "Connected Corridor." The vision for this project is to deploy this technology along a selected route between downtown Minneapolis and I-494. In addition, they intend to implement connected vehicle infrastructure at ramp intersections along the parallel I-394 corridor so that additional applications related to corridor management may be explored.

Maryland reported they have a business unit focused on connected vehicles on the US 1 corridor. This section is an 8-mile corridor of US 1 (4-lane arterial) with 2 miles of MD 175 (2-lane) with DSRC deployment at intersections in support of the SPaT challenge. This project is currently in the design phase with a full deployment expected by the summer of 2019. MDOT is also testing DSRC installations at tunnels in the state, and they have facilitated DSRC Collaborations with US Army Aberdeen Test Center.

Virginia DOT envisions a future where CAV applications provide connectivity between vehicles, roadside infrastructure and wireless devices. This connected environment would increase safety and mobility while reducing infrastructure requirements and enhancing traveler information and comfort. VDOT established a CAV executive steering committee, and then released their Connected and Automated Vehicle Program Plan (http://virginiadot.org/automated) in the spring of 2017. This plan serves as their strategic plan for implementation of this new technology.

Virginia DOT is also a member of the Connected Pooled Fund study which is a partnership of transportation agencies that have established a program to facilitate the development and evaluation of CV applications. This pooled fund project was started in 2009, and has grown steadily ever since. The pooled fund study works to:

- Develop and demonstrate connected vehicle technology, algorithms, tools, and applications.
- Help states prepare for field deployments.
- Develop and deploy documentation concerning CAV technologies.
- Share lessons learned and challenges identified from field deployments.

Research reports from past projects can be found at http://www.cts.virginia.edu/cvpfs_research, Members as of June 2018 can be seen in Figure 6 below.

Figure 6: CAV Pooled Fund Participants as of June 2018

Arizona is currently working on a CAV pooled fund project on Multimodal Intelligent Traffic Signal Systems. This project is working to build a connected corridor to promote signal priority for a variety of modes of transportation. Priority for one corridor will be assigned in a hierarchy, as follows: trains (at grade rail crossings: emergency vehicles: large trucks: transit: passenger cars; and, pedestrians. A second corridor will provide priority for transit and pedestrians before any other modes. This project uses adaptive signal control, with requests from connected vehicles and pedestrians (via a cell phone app), to alter signal phasing to prioritize green signals based on a defined hierarchy. Tests in the field resulted in a 3.8% reduction in travel time, and produced a much more reliable travel time with a 21.8% reduction in travel time standard deviation. This indicates that, with increased market penetration of connected vehicles and more connected vehicle data, traffic control systems can be improved, travel times can be decreased, and environmental impacts of vehicles can be reduced. However, market penetration is one of the major challenges for this technology. Until more vehicles are equipped and smart signals are deployed, the benefits of this technology will not be fully realized.

Toyota is currently researching connected vehicle technology with deployments in Japan. Toyota's approach to DSRC deployment is to rely on specifications and standard protocols based on industry consensus while protecting privacy and security. Those standards currently identified include: IEEE 802.11 WG; IEEE 1609 WG; and, SAE DSRC TC. The deployments include technologies for:

- **Turning Movement Collision Caution** to alert drivers of a potential crash from turning across traffic.
- **Red Light Caution** to warn drivers of red light and prevent running the signal.
- **Signal Change Advisory** to notify drivers when the light will change and smooth starting from a stop.
- **Radar Cruise Control** to help vehicles follow smoothly with a constant headway.
- **Emergency Vehicle Notification** to alert drivers of nearby emergency vehicles and the location of the emergency vehicle (in front, behind, right or left).
- **Crossing Collision Warning** to alert drivers of a potential crash from crossing traffic.

Toyota currently supports collaboration to achieve full deployment of DSRC through the preservation of the 5.9GHz Intelligent Transportation Systems (ITS) spectrum, with voluntary compliance in the short term followed by mandated V2V technology in the future. According to

James Lentz, Toyota Motor North America Chief Executive Officer, “We [Toyota] believe that greater DSRC adoption by all automakers will not only help drivers get to their destinations more safely and efficiently, but also help lay the foundation for future connected and automated driving systems.”

NYC is also in the midst of a pilot program of connected vehicles. The purpose of this project is to improve the mobility and safety of travelers in NYC, while also alleviating congestion through V2V and V2I applications on arterials with high crash rates. The project goals are to assess the benefits of an application of CV technology in a dense urban environment, with respect to safety and mobility. The study focuses on equipping up to 8,000 fleet vehicles to generate a considerable number of V2V interactions which will allow the city to develop strategies to address daily operations of connected vehicle technologies. Furthermore, 353 roadside units will be deployed to provide connectivity to infrastructure in Manhattan and Brooklyn. Figure 7 outlines the application that NYC DOT hopes to assess.

Vehicle-to-Vehicle Safety Applications

- Forward Collision Warning
- Emergency Electronic Brake Light
- Blind Spot Warning
- Lane Change Warning/Assist
- Intersection Movement Assist
- Vehicle Turning Right in Front of Bus Warning

Vehicle-to-Infrastructure Safety Applications

- Red Light Violation Warning
- Speed Compliance
- Curve Speed Compliance
- Speed Compliance/Work Zone
- Oversize Vehicle Compliance
  - Prohibited Facilities (Parkways)
  - Over Height warning
- Pedestrian in Crosswalk
- PED-SIG
- Emergency Communications and Evacuation Information

Figure 7: NYC DOT Connected Vehicle Applications Evaluation

NYC shared some lessons learned from their DSRC deployments that certain intersections do not fit neatly into the mapping template of the DSRC software. Intersections with varying widths and complicated foot traffic patterns needed a creative solution to transmit the appropriate data and geometry. This is an area where the technology needs to mature and advance to accurately convey the traffic flow and configuration to vehicles.

Similarly, BMW projects that, by the end of 2019, they will have 500,000 electrified vehicles on the road. As of April of 2018, BMW had sold 36,692 electrified vehicles, as reported by Jan Urbahn.

Minnesota DOT is exploring a Connected Corridor Project which identifies a route to deploy V2I technology to improve safety and efficiency of roadway users (http://www.dot.state.mn.us/its/projects/2016-2020/connectedcorridors.html).

Colorado is expanding a connected vehicle pilot program along approximately 90 miles of the I-70 Mountain Corridor between Golden and Vail. CDOT is working with Panasonic to build the connected vehicle foundation that is at a scale that begins to solve problems. This new data frontier has been branded the internet of roadways (IoR). Once implemented this system will generate approximately 82 million messages, i.e., approximately 23Gb of data, every hour. The vast majority of messages will not be significant and routine. This big data generation will allow for research and analysis into viability of connected transportation technologies. The deployment of fiber optic cable along the transportation network will serve as the backbone of the system in rural areas like those found in Colorado. The expected outcome of this deployment is to produce defined safety benefits. CDOT has developed crash modification factors (CMFs) for this new technology. Traditionally CMFs are used to estimate the safety impacts of standard treatments such as a protected left turn phase, rumble strips or narrowing of travel lanes. The CMFs developed by CDOT are the first of their kind in an effort to quantify the direct benefit of this technology. The predicted CV CMFs can be found in Figure 8.

Quantifying the safety benefits of connected vehicles

Connected Vehicle Application	CMF Equivalent	% Reduction (PDO, Injury, Fatality)
Spot Weather Warning	Variable Message Signs	25%
Roadway Departure Warning	Rumble Strips	11% — 16%
Queue Warning	Queue Ahead Warning	16%
Dynamic Speed Harmonization	Variable Speed Limits (VSL)	19%

First-ever methodology created by CDOT Traffic Safety (David Swenka)

Figure 8: CDOT Connected Vehicle Crash Modification Factors

Regional Issues Unique to the Northeast

The New England Transportation Consortium (NETC) has kicked off a rapid response research project to evaluate cross border issues within the New England states. This is a research cooperative between the six New England states funded out of a pooled fund that is administered by NETC. This initiative was inspired by last year's Northeast Automated Vehicle Summit in Mystic, CT. A stakeholder workshop was hosted with 28 attendees from all six states. Preliminary cross-border issues have been categorized into:

1) Legal and regulatory

- Vehicle Registration
- Driver Licensing
- Crash Investigation
- Insurance
- Freight Regulation and Policy

- Pilot Testing/Deployment

2) Infrastructure

- Communication Network
- Roadside Units
- Infrastructure Standards
- Gravel Roads

3) Operations

- Transportation Management Center (TMC) / Highway Operations Center (HOC) Role
- Operations Between State Lines
- International Vehicles
- Outreach, Behavior, Education

4) Data and technology

- Data Gathering
  - Infrastructure Data from AVs
  - Data from Roadside Units
  - Key AV Functions
- Network Resilience/Cybersecurity

Partnerships

Navya is a leading name in the autonomous vehicle industry. Navya offers mobility solutions with autonomous, driverless, and electric vehicles. Navya has partnered with the University of Michigan's simulated city (Mcity) by deploying a fully automated, 11-passenger, all electric autonomous shuttle in a secure environment. This shuttle is the first North American vehicle that Navya has operated. The shuttle covers a one-mile round trip route around part of campus and transports students and faculty and staff from a distant parking lot to the Research complex. In this project, Mcity intends to study passenger reaction to the driverless shuttles in order to gauge acceptance of the technology. External cameras will capture video and audio recordings of other road users' reactions and behaviors. Interior cameras will capture shuttle riders' behavior. The data Mcity gathers will assist in understanding user trust. The University of Michigan's Transportation Research Institute has been engaged in several projects, including one titled, "Connected Vehicle Safety Pilot Model Deployment," which was funded by USDOT. For this pilot, nearly 3,000 private cars, trucks and buses with were outfitted with DSRC devices along a specific route in Ann Arbor. Findings from this study are being used by USDOT to inform current policy decisions.

<u>Figure 9: Mcity Autonomous Shuttle</u>

Chapter 4: Conclusions, Recommendations and Suggested Research

As a follow up to the summit, the Committee sent a post event survey to all attendees to elicit feedback. The survey questions can be found in Appendix C. The intent of the survey was to gather information regarding lessons learned, key takeaways from individuals, ideas attendees would take back and implement in their state and how to proceed with future summits and topics. Approximately 25% of attendees completed the survey. A summary of their responses is below.

Many of the survey respondents after the summit were surprised how fast this technology was moving and that there were pilot programs up and running. This is a major shift from the last conference where many pilots were just being announced and real-world testing was very limited to only OEMs in closed areas. One respondent noted: "This was the first conference I've attended where the tone was, 'This is what we've done and this is what we learned' rather than 'This is what we're planning to do.' "

One of the major overall takeaways from the summit, as reported by attendees, can be summarized as collaboration being key to successful and efficient deployment, testing, and knowledge transfer. Much more can be learned and achieved as a collective whole rather than each state working independently. There are many challenges facing AVs and CVs in the Northeast and throughout the country. One prevalent concern was the lack of coordination between states, research centers and the developers of this technology. This perceived disconnect could become an obstacle to making this technology a reality. Participants noted that there is no framework in place to integrate across multiple interests. Another related concern was lack of a common goal between OEM's and state agencies. Manufacturers of this emerging technology and state agencies must align their visions and strategies as development and deployments move forward. Government standardization of rules and regulations relating to AV and CV technology was identified as another issue that must be addressed. With a technology that is rapidly advancing and constantly diverging, government must remain agile and respond accordingly.

Infrastructure continues to be a main concern regarding AVs and CVs. There are still so many questions, yet few decisions are being made on this topic. Questions were raised on:

1) How should states coordinate the infrastructure needed for AVs and CVs while still maintaining the current infrastructure for non-AVs?

2) Would infrastructure be able to handle private ownership of AVs and shared service AVs?

3) Who will fund the changes needed to current infrastructure?

As discussed in detail throughout this report, there are many pilot projects being conducted throughout the United States. The results of these pilot programs must be shared across state lines and are necessary to assist other states attempting to answer some of these questions. The survey responses, and even the summit presenters, acknowledged the need for collaborative projects, research, pilots and peer exchanges to share knowledge and lessons learned.

Consumer education emerged as another concern that will need to be managed. There is an assumed lack of public knowledge and acceptance of this technology and the fear is that this will only increase as this technology advances and more crashes occur. Key questions raised where:

1) How can the public become more aware of these technologies?

2) How will the public receive this information?

3) How will the public be educated?

As discussed previously, AAA conducts AV surveys on a continuous basis. The most recent results showed that 72% of those surveyed stated that safety and reliability was their primary concern. Attendees concurred with these findings, responding that consumer education and public perception is a major challenge going forward. Consumer education and acceptance, infrastructure, policy and interstate/interagency coordination were among the top challenges the survey results showed. There were also several others mentioned, including weather, divergent rural/urban needs, funding, and safety.

According to the survey, there were a number of concerns and challenges regarding various aspects of AVs and CVs. However, learning how different state agencies are approaching these issues was found to be beneficial. Research in this technology continues to increase, which will, ultimately, result in a vision that can be adopted. Another key outcome of the summit was the realization that many of the same discussions are taking place across multiple state agencies, and that resources are being made available to address many of the questions that have yet to be answered. Learning about other opportunities such as the SPaT challenge, I-95 corridor coalition, and Connected Vehicle Pooled Fund Study made states aware of networking and collaboration opportunities between state agencies and potential OEMs. This was a key takeaway from this event that many attendees mentioned as part of the post summit communications.

An overall recommendation from survey results is that specialized discussions must continue; partnerships need to be fostered; strategic plans need to be developed; and, a clear vision for the future testing and implementation of this technology needs to be defined, but also be fluid. Many referred to their plans as living documents that will need to adapt and be updated on a regular cycle to address the latest advancements in technology. Furthermore, continuous and diverse working groups, which include OEMs and regional agencies, are needed to arrive at a common vision. Maryland reported the following lessons learned: collaboration is key; every document is a living document as this technology and policy are changing too rapidly; AV and CV needs must be integrated into a long-range plan, of which technology capabilities are just one element; and, user acceptance and integration into transportation culture will be key for CAV development.

Chapter 5: Implementation of Research Results

The implementation of information obtained from this summit is specific to each attendee. Attendees left the summit with examples from other states and agencies on what they should be doing with respect to strategies for implementing new programs, pilots, or consortiums to join. This report will hopefully serve as a resource over the next 12 months that states can use to develop plans and make contacts with partners across the Northeast. The goal of this event, which is anticipated to be hosted on an annual basis, is to become the primary networking event each year for AV and CV technology in the Northeast.

References

AAA. 2018a. AAA Finds Partially Automated Vehicle Systems Struggle in Real-World Conditions. https://newsroom.aaa.com/2018/11/americans-misjudge-partially-automated-driving-systems-ability-based-upon-names/

AAA. 2018b. AAA: American Trust in Autonomous Vehicles Slips. https://newsroom.aaa.com/2018/05/aaa-american-trust-autonomous-vehicles-slips/

NTSB. 2018. Preliminary Report Highway HWY18MH010. https://www.ntsb.gov/investigations/AccidentReports/Reports/HWY18MH010-prelim.pdf

APPENDIX A: Agenda

June 12, 2018: Autonomous Vehicles *(7:00am - 4:30pm, Breakfast, Lunch and Networking Breaks Included)*		
7:00 - 8:00	Registration, Breakfast, Booths and Networking	
8:00 - 8:05	Welcome and Opening Remarks	Connecticut DOT - Anna Barry, Deputy Commissioner
8:05 - 8:55	Autonomous Vehicles Perceptions, Safety and Crash Investigations -Consumer Acceptance on the Road to Autonomy -NTSB Automated Vehicle Crash Investigations	American Automobile Association - Jennifer Ryan, Director of State Relations National Transportation Safety Board - David Pereira, Senior Highway Crash Investigator
8:55 - 9:25	Autonomous Vehicles Impact on Transit	WSP - Stephen Buckley, Northeast Regional Manager, Planning, Environment and Traffic Practice
9:25 - 9:55	Mobilitics: CAV Scenario Planning Tool for Public Agencies	AECOM - Dalia Leven, Consulting Manager
9:55 - 10:10	Morning Break, Booths and Networking	
10:10 - 10:40	Model State Guidelines for Autonomous Vehicles	American Association of Motor Vehicle Administrators - Cathie Curtis, Director of Vehicle Programs
10:40 - 11:30	Opportunities for Autonomous Vehicle Pilot Projects and Programs: -Rhode Island Transportation Innovation Partnership: Autonomous Vehicle Mobility Challenge -Connecticut's Fully Autonomous Vehicle Testing Pilot Program (FAVTPP): An Overview	US DOT Volpe Center - Elizabeth Machek, Community Planner (moderator) Connecticut Office of Policy and Management - C. Zack Hyde, Senior Transportation Policy Advisor Rhode Island DOT - Julia Gold, Chief of Sustainability, Autonomous Vehicles, and Innovation
11:30 - 12:00	Lunch Break, Booths and Networking	
12:00 - 1:15	Featured Lunchtime Autonomous Vehicle Presentations and Discussions with BMW and Navya	US DOT Volpe Center - Jonathan Koopmann, Division Chief-Technology Innovation & Policy Division (moderator) Navya - Tim Schock, North America East Development BMW - Jan Urbahn, Head of Car Sharing Services Unit in United States
1:15 - 1:30	Afternoon Break #1, Booths and Networking	
1:30 - 2:45	Lessons Leanred from Autonomous Vehicle Pilot Projects and Programs: -Learning by Doing: Lessons from Boston -Minnesota DOT Autonomous Vehicle Shuttle Testing in Winter Conditions	US DOT Volpe Center - Elizabeth Machek, Community Planner (moderator) City of Boston - Kris Carter, Co-Chair, Mayor's Office of New Urban Mechanics Minnesota DOT - Jay Hietpas, CAV-X Office Director
2:45 - 3:00	Afternoon Break #2, Booths and Networking	
3:00 - 3:55	Panel Discussion on the Future of Autonomous Vehicle Technologies and Data: Impacts on Policy, Safety and Infrastructure	US DOT Volpe Center - Jonathan Koopmann, Division Chief-Technology Innovation & Policy Division (moderator) Mobileye - Dan Galves, Senior Vice President for Communications Mapillary - Janine Yoong, Vice President of Business Development Mcity - Carrie Morton, Deputy Director Local Motors - David Woessner, General Manager National Governors Association - Garrett Eucalitto, Transportation Program Director
3:55 - 4:00	Closing Remarks	Connecticut DOT - Anna Barry, Deputy Commissioner
4:00 - 5:00	Networking Reception in Atrium	

June 13, 2018: Connected Vehicles *(7:00am - 3:30pm, Breakfast, Lunch and Networking Breaks Included)*		
7:00 - 8:00	Registration, Breakfast, Booths and Networking	
8:00 - 8:05	Welcome and Opening Remarks	Connecticut DOT - Anna Barry, Deputy Commissioner
8:05 - 9:05	Regional CAV Activities Update -Maryland CAV -New England CAV Cross-Border Research Project -I-95 Corridor Coalition CAV	US DOT Volpe Center - Kevin Walsh, Environmental Biologist and Project Manager (moderator) Maryland DOT Motor Vehicle Administration - Chrissy Nizer, Administrator Vermont Agency of Transportation - Joe Segale, Director of the Policy, Planning and Research Bureau I-95 Corridor Coalition - Marygrace Parker, Director, Freight and Innovation in Transportation
9:05 - 10:00	Opportunities for States to Get Involved with Connected Vehicles -Signal Phase and Timing (SPaT) Challenge -Connected Vehicle Pooled Fund Study	US DOT Volpe Center - Kevin Walsh, Project Manager (moderator) Gannett Fleming - Laurie Matkowski, Vice-Chair, Board of Directors and Director, Connected and Automated Vehicle Services Virginia DOT - Virginia Lingham, P.E., Special Assistant, Innovation
10:00 - 10:15	Morning Break, Booths and Networking	
10:15 - 11:30	Lessons Learned from Connected Vehicle Pilot Projects & Programs (part 1): -Active Aurora Connected Vehicle Testbed (Canada's Largest AV/CV Testbed) -Multi-Modal Intelligent Traffic Signal Systems	US DOT Volpe Center - Jeffrey Bellone, Economist (moderator) Stantec - Michelle Orfield, Smart Mobility and Transit Planner + Dan Baxter, Systems Engineer University of Arizona - Dr. Larry Head, Acting Dean of the College of Engineering and Professor of Systems and Industrial Engineering
11:30 - 12:00	Lunch Break, Booths and Networking	
12:00 - 12:45	Moving Together Towards a Mass DSRC Deployment	Toyota Info Technology Center - Hongsheng Lu, Researcher
12:45 - 2:00	Lessons Learned from Connected Vehicle Pilot Projects & Programs (part 2): -NYC Connected Vehicle Project -Colorado Platform for Connected Vehicles	US DOT Volpe Center - Jeffrey Bellone, Economist (moderator) Transcore - David Benevelli, Associate Vice President Panasonic - Kellen Pucher, Director of Strategic Initiatives for Smart Mobility
2:00 - 2:15	Afternoon Break, Booths and Networking	
2:15 - 3:15	Panel Discussion on the Future of Connected Vehicle Communication Technologies and Data: Impacts on Policy, Safety and Infrastructure	US DOT Volpe Center - Jeffrey Bellone, Economist (moderator) AECOM - Suzanne Murtha, Vice President Connected and Automated Technologies Harman - Darrin Shewchuk, Senior Director Corporate Communications & Global Head of Connected Car Communications Transcore - David Benevelli, Associate Vice President University of Arizona - Dr. Larry Head, Acting Dean of the College of Engineering and Professor of Systems and Industrial Engineering HDR - Eric Plapper, Project Manager, Transportation Technology
3:15 - 3:30	Closing Remarks	Connecticut DOT - Anna Barry, Deputy Commissioner

APPENDIX B: Pre-Event Survey – Questions and Responses

What topics would you like to see covered?	Would you prefer a 1 day conference or a 2 day conference?	Would you prefer a large session format or breakout groups or a combination of both?	Would you be interested in presenting, or do you have someone you would recommend to present? If you are interested in presenting, please provide your contact information.
How the current infrastructure would have to be changed to adapt to the new technology.	2 day	Breakout Groups	
More on Otto CMV and more on the new tesla CMV.	1 & 1/2 days	Large Session	NA
Emerging Technologies Investment sources and opportunities Partnership	1	Both, start with large session then break out	
Advances in AV technology since the last summit, Auto manufactures plans for the future, successful autonomous vehicle testers	1 day	Combination	
data security, comparisons/results of AV testing that is ongoing, consumer sentiment/adoption/adaptation, hear from top 3-5 companies leading the transportation transformation, learn about any legislation on state and federal level that may support/hinder innovation.	whichever is needed to provide best content.	again, whichever format best conveys new information. not married to either	AAA is about to release new research that indicates consumer sentiment is changing around AVs, fearing is waning, etc. Would welcome opportunity to again have someone from AAA share latest research/findings. If you are interested, let me know and I will connect you with most appropriate person. Amy Parmenter 860-965-6161
Unfortunately, was not able to attend the original summit so case studies on where states are in the AV development process would be helpful. Roadmap for the future would be interesting with timelines.	Would prefer one day but if there were compelling topics presented, could allocate two days in my schedule.	Combination of both	Not my area of expertise
impact of AV on motoring public Case studies from those communities that have begun to integrate...benefits,lessons learned, etc Update on any legislative initiatives	2 to allow time for discussion	combination to allow for variety in topics/presentations	
Discussion about levels of autonomy. Status of AV legislation in northeast states. Plans for testing in the Northeast. Perspective from state DMV's on licensing. New development re: AV technology.	One day conference	A mixture of both.	I would be happy to provide perspective from AAA consumer research on public attitudes / perceptions of AV's. My name is Lloyd Albert, SVP at AAA Northeast - lalbert@aaanortheast.com
AV impacts on activity and travel behaviors AV service offerings Hear insights from industry players who not only develop this technology but are also applying it for offering mobility services	2 day conference	A combination of both	I would like to present at the conference - my contact information is Karthik Konduri, email: karthik.konduri@uconn.edu
Energy and environmental impacts - i.e. what is the impact on VMT? Ethics of AV decision-making and societal role in setting these Cyber security	Split the difference 1 full day and a morning session.	Combo.	
Legal issues State responsibilities for Autonomous Vehicles Increased infrastructure standards, and the associated costs What are Vehicle manufacturers looking for from the States? What is being done by both sides to ensure consistent operational situations across state lines? Autonomous vehicle performance in work zones " " " " moving work zones " " " " winter weather conditions	Whatever is necessary	Combination	If NJDOT is able to send a representative, yes, we would be interested in presenting. It may not be me, but I can be the contact. Bill Kingsland Asst Commissioner Transportation Systems Management NJ Dept of Transportation 609-530-4690
Truck platooning. How do we plan for truck platooning, how soon can we expect truck platoons, what are the safety issues, should truck platoons be limited to certain highways	1 day	Combination. Break out groups need to be well structured.	We completed outreach efforts in VT as the basis for a report ti the legislature that recommends we move forward with legislation that allows testing of AVs and the would explicitly allow and regulate the deployment and operation of AVs by the general public. The report does not provide any new reearch report, but I would be happy to report back on our efforts to prepare for AVs in VT after we meet with legislators in the next couple of months.
Legal implications of crashes/statutory redefining of "operator for AVs/	One day would be fine.	A combination of both with major issues covered in a large format and the opportunity to choose one of several more specific topics in a smaller setting.	I would recommend Zach Hyde of the Office of Policy and Management to discuss the statewide AV Pilot Program under development.
The integration of vehicles into the Roadway Infrastructure-what structure improvements will need to be made to improve the success of the AV? Special signage, street markings,shoulder and median markings,etc..?	1	large as breakouts you miss things you want to hear about as they maybe running concurrently.	no expertise in this area.
motor vehicle accidents, specific to police finding fault.	1 day	large session	unknown
pilot studies, how technology will be decided when ethical implications are an issue, CT state legislative support	1 day	large session format	Global Autonomous Vehicle Partnership
Mini-bus transit projects Truck platooning and other motor carrier applications Legal framework for states Opportunities for state coordination Infrastructure needed in the Northeast Pilot projects in this region State of the technology for personal vehicles Data needs and systems SPaT challenge Insurance industry readiness Cybersecurity	We prefer one overnight. This could mean a one-day conference, or start noonish first day and adjourn early p.m. second day.	A combination	No recommendations at this time.
How AV's will navigate in adverse weather and work zone conditions.	Depends on the content. There's a lot to learn, so if it's new material, 2 days is doable.	I think a combination would be best, with a majority of breakout groups and one or two keynote addresses.	Paul Carlson, formerly of Texas Transportation Institute and now with Ennis-Flint. He has done a lot of work with the auto industry.
Incident Management for Autonomous vehicles, regarding uniformed traffic control, vehicle breakdowns, and yes crashes. Protocols for vehicles (Regulatory speed vs, safe speed based upon road conditions such as sight lines,traction, road geometry etc.). Insurance liability for autonomous vehicles. What infrastructure is recommended? Such as(Signing, edge line markings, temperature sensors in pavement). How will vehicles handle highway merging, weaving exiting. Will the required gaps between vehicles improve or reduce highway, arterial roadway capacity?	One day.	Breakout format.	No. Not knowledgeable enough.
Presentation on implementation challenges - operational, legal, insurance, and other challenge issues of importance	Depends on information needed to cover and if there is value in having two vs one day conference.	Prefer to hear all information in single sessions	
Empirical data gathered through practical CAV implementation as opposed to data gathered through survey participation. Data sharing best practices. How to prepare for Big Data.	2 day conference	a combination.	No.
- Progress since last meeting - Governmental changes in these areas - How teams can work together to develop technologies, preferably highlighting examples - Infrastructure improvements - High level view of improvements in autonomy over the last year - Discussion of ways connectedness might look 10, 20, 30 yrs later	2 day provided there is sufficient reason to be there for the second day. I thought the first day offered an opportunity to learn from the organization and the next day offered an opportunity to network and share information; it was a good format. I'm sure there are other activities that can be encouraged for day 2 that would allow similar interactions	Combination - see prior note on appreciation of prior engagement methods	Depending on topic, may not have sufficient content/permission to share but willingness is there. Enrico Nino Manes manesen@utrc.utc.com (860) 610-7289
Interoperability of systems being designed by different manufacturers (the technology used by Toyota vs. Honda may be similar, but it's essentially all proprietary to each manufacturer). Could this cause problems down the road when all vehicles will be communicating with each other? Laws associated with driverless vehicles. If there's a crash, who's at fault? Insurance impacts, etc.	1 Day Conference	Large Session	
I would be interested in hearing from major traffic signal equipment manufacturers to see what products they will be offering in the future for autonomous vehicles. This may provide some insight on how we should be modifying our current designs to accommodate future traffic signal equipment and potentially make transitioning to "autonomous vehicle-friendly" traffic signals easier.	No preference.	I prefer the large session format with open discussion.	N/A
Implications of autonomous vehicles on road safety and planning	the format last time was good. 1 day of presentations and 1 day workshop for state officials for response.	it depends on the scope of topics. If there is a broad scope of topics that would be of interest to different audiences with little overlap, then break out groups sounds good. Otherwise it might be best to have large sessions so no one has to miss anything. it depends on the number of speakers you are able to get, too.	I would be willing to speak about implications for safety. john.ivan@uconn.edu

APPENDIX C: Post-Event Survey - Questions

1. What do you see as the biggest challenges facing autonomous vehicles and connected vehicles in the Northeast?

2. What would you describe as a key takeaway from this summit?

3. How do you expect this summit to impact your or your organization's planning for autonomous and/or connected vehicles?

4. What about this summit interested you the most?

5. What about this summit interested you the least?

6. How satisfied were you with the venue? Please leave comments for any location or venue preferences for future summits.

7. For future summits, would you prefer: 1 day; 1.5 days; 2 full days?

8. For next year, would you prefer including small focused breakout sessions?

9. Did the summit provide an appropriate amount of networking opportunities?

10. Please provide any additional comments or suggestions you may have (optional)

*What type of Organization are you from?

*Is your organization or where you work based in Connecticut or outside Connecticut?