SEPTEMBER 15, 2021

MINNESOTA GOVERNOR'S ADVISORY COUNCIL ON CONNECTED & AUTOMATED VEHICLES

Learn about Cavnue's infrastructure investment model and Minnesota CAV updates







WELCOME

Margaret Anderson Kelliher, Co-Chair Commissioner, MnDOT

Phil Magney, Co-Chair CEO and Founder, VSI Labs



AGENDA

- 1. Welcome
- 2. Cavnue Presentation
- 3. Minnesota CAV Updates
- 4. Public Comment
- 5. Closing



- 1. Margaret Anderson Kelliher MnDOT
- 2. Amber Backhaus Automobile Dealers Association
- 3. Dan Chen 3M
- 4. Ryan Daniel St. Cloud Metropolitan Transit
- 5. Danielle Elkins City of Minneapolis
- 6. Michael Gorman Split Rock Partners
- 7. John Hausladen Minnesota Trucking Association
- 8. Phil Magney– VSI Labs
- 9. Myrna Peterson Mobility Mania
- 10. Edward Reynoso Teamsters Joint Council
- 11. Damien Riehl Fastcase Legal Research Platform
- 12 Vicky Rizzolo American Family Insurance
- 13. Kyle Shelton University of Minnesota CTS
- 14. Bret Weiss WSB
- 15. Patrick Weldon Polaris

OTHER PARTICIPANTS

In the chat box please share...

- 1. Your name
- 2. Your role
- 3. Your organization





PREVIOUS MEETING RECAP AND TAKEAWAYS

- Discussed & approved the CAV Guiding Princip
- Learned about CAV in long-range planning, including CAV scenarios, our statewide multimodal plan and our highway investment plan
- Breakouts discussed equity and safety, broadband, pedestrian safety and transit and shifting travel patterns due to the pandemic
- Discussed future meeting topics including our outreach work, local CAV businesses, our CAV Safety Committee work and others

Minnesota's CAV Guiding Principles

In 2018 Minnesota established the Governor's Advisory Council on Connected and Automated Vehicles (CAV) and the CAV Office to help the state plan and prepare for emerging transportation technologies. The Council developed the state's CAV vision, mission, and goals. Below are the state's CAV Guiding Principles, developed support from the CAV Innovation Alliance and the Minnesota Office of Connected and Automated Vehicles ("CAV-X").

The goal of these Guiding Principles is to help stakeholders ask the right questions when developing CAV policy and programs in directing investment to advance a transportation system that is safe, equitable, accessible, efficient, healthy, and sustainable. These principles have the most potential when working together in synergy.

These principles help advance the U.S. Department of Transportation's vision of transportation that as an "imaginative, bold, forward-thinking engine for equity" that improves quality of life. - Secretary of Transportation Pete Buttigieg.

Minnesota CAV Guiding Principles

Below are Minnesota draft CAV Guiding Principles. Each of these principles has general policy statements, followed by key questions to ask policy makers, government; industry, and community when developing new CAV programs or policies. These questions can be asked when developing policy, when scoping and selecting projects, and in evaluating program success and can be shared with local agencies, communities, and stakeholders. Principles including safety, equity and innovation should be principles reflected through all these policy and programmatic priorities. These principles are not in hierarchical order, rather they are meant to be holistically considered when developing new ideas or programs.

- Safety is Paramount Continue to work towards a transportation system that has no fatalities and decrease severe and serious crashes. Provide multi-modal safe systems that promote transportation efficiency. Proactively address disproportionately impacted demographics that are over or under-represented in traffic safety data.
 - Supportionately impacted beingraphics that are over on whole "percentionately impacted beingraphics that are over on whole splices, need to make your and the modes? Does this advance the state's Safe Routes to Schools, State Highway Safety Plan and other community health gala? Does this advance the state's Safe Routes to Schools, State Highway Safety Plan and other community health gala? Does this provide appropriate regulatory oversight to ensure compliance with safety gala? Can the CAV safety return control if an error occurs? Can the CAV practicle predict the behavior of other drives and road users? How does the CAV follow traffic Laws? Does the CAV alert operators when they need to take over, if applicable? How does this provide a valide or tested? Is the technology safe from cyber-attack and security risks? How does the Schools and Hishway Safety Plana? Zoes this provide a safety benefit to diverse geographical and/or for diverse demographics in the state? Does this provide a safety benefit to diverse geographical and/or for diverse demographics in the state? Does this create a more welcoming and physically safe environment for propel of all modes?
- 2. Advance Transportation Equity Advance policies that promote transportation equity. View our work through an equity lens. Meaningfully engage communities to have a voice in expressing how CAV can advance their goals. Recognize transportation's role in dividing communities and recommit to removing systemic barries. Improve affordable access to destinations in all areas, from rural communities and people of all abilities. Uphoid public interest with clarity and transportation's ransportation equity ensure the benefits and burdens of transportation spending, services, and systems are fair, which historically have not been fair, and people especially Black, Indigenous and People of Color are empowered in transportation decision making.
 - <u>Equity questions to ask</u>: Who was involved in the decision or policy development? Does the policy lead to disparate impacts to any one community? Does this advance the state's racial equity and social justice goals? Did you engage the public to understand community goals to use CAV technology? Did you engage communities directly impacted by the project or program? Did you allow input and feedback from the public to impact work where appropriate? Have you aggeed Black, Indigenous and communities of cicit? Did you

CAV Guiding Principles





CAVNUE

TYLER DUVALL, CEO OF CAVNUE

GOAL: LEARN ABOUT CAVNUE'S INFRASTRUCTURE INVESTMENT MODEL





The future of roads.

Governor's Advisory Council on Connected and Automated Vehicles September 15, 2021

Overseeing infrastructure is an evolving challenge



Safety



"

Minnesota Reports More Than 200 Traffic Fatalities, Most At This Point Of Year In A Decade¹

Congestion



"

MnDOT says that statewide, traffic volumes have returned to normal²





"

Truck freight traffic (in Minnesota) projected to increase 30% by 2030³

Equity



"

(in Minnesota) access to services and amenities affects people with low incomes, people of color, older adults, and people with disabilities⁴

Climate



"

the number of large wildfires has tripled in the west since 1970, and the number of air quality alerts in Minnesota is rising fact⁵

¹ - Minnesota Reports More Than 200 Traffic Fatalities, Most At This Point Of Year In A Decade (msn.com)

²- Traffic congestion quickly returning to normal, teleworking still affecting morning commute | KSTP.com

³ - Transportation 2020-21 Governor's Revised Biennial Budget Recommendations (mn.gov)

4- Advancing Transportation Equity District 4 Executive Summary-12220820-v1.pdf

⁵ - Climate change, some bad weather luck behind Minnesota's smoky summer | MPR News

Cavnue update

AVs have a complexity problem...



"By 2017, a Tesla will be able to drive from LA to Times Square without a single touch of the steering wheel" Elon Musk, CEO in 2016



"We will have a Level 4 vehicle in 2021 – no gas pedal, no steering wheel, and the passenger will not need to take control"

Mark Fields, CEO in 2017

- Initially, rapid progress fed rampant hype
- •Today, **hype has been tempered** by high profile safety events and intractable technical challenges
- •To date, a **publicly announced timeline goal** for L4 deployment has **never been met**

Level -4 autonomy has not arrived, but Level -2 features are (reaching market scale

					Est. sales volume, K		
OEM		Intro year	Models ¹ , #	Examples	2020	2023	Headlines
gm	General Motors Super Cruise	2020	22	 Cadillac Lyriq Buick Encore 	37.6	177.3	GM's Super Cruise Self-Driving Tech Will
Ford	Ford BlueCruise	2020	11	 Mustang Mach-E F-150 SuperCrew 	3.7	52.7	Be on 22 venicies by 2023 Feb 2021
Ŷ	Tesla <i>Autopilot</i>	2020	5	• Model X • Model 3	153.5	302	11 Tesla Full Self-Driving subscription model
VOLVO	Volvo Pilot Assist	2023	2	Volve XC90Volvo XC100	0	7.6	Mar 2021
	Volkswagen Traffic Jam Assist	2020	12	• Volkswagen Atlas • Audi A4	27.4	52.1	
NISSAN	Nissan ProPilot Assist 2.0	2021	2	Infiniti QX50Infiniti QX55	0	5.5	2021 Toyota Camry is
1 Estimated	Toyota SafetySense 2.5	2021	46	• Toyota Camry • Lexus LX	0	421.6	first to get Safety Sense 2.5 Plus Jul 2020

Road infrastructure isn't keeping up with vehicle technology



The more test -miles OEMs accrue, the more they understand how much complexity they still can't account for

Initial problem formulation

- Simple problem: lateral (torque) + longitudinal (acceleration / deceleration)
- •Underestimates the complexity of the road



Supportive infrastructure can radically simplify the complexity problem

Simplify

Sense + See

Inform + Coordinate

Permit + Penalize

We simplify and enhance the driving
environment to address disengagements andCOVNUEenable a hands-off, eyes-off driving experience

HIGHLY CONFIDENTIAL | DO NOT DISTRIBUTE | CAVNUE PROPRIETA

Cavnue Team









Jaime Waydo Chief Technology Officer Former Waymo Chief Systems Engineer; most recently led Apple's autonomous systems efforts







Nicole Nason Chief Safety Officer, Head of External Affairs

Former Administrator of both FHWA and NHTSA









Mark de la Vergne Project Development Former mobility lead for City of Detroit





Dave Clifford Strategic Innovation and Analytics Former head of AI/ML at General Motors

DARPA



Dino Nardicchio Automotive & AV Partnerships Former Global VP of R&D Magna International

MAGNA

|g<u>m</u>|



Pete Kenny General Counsel Former multi-vertical legal lead at

HP and VP/DGC at Perspecta

perspecta.

■X DXC.technology



David Kiley Business Development

Former managing director of municipal finance at Piper Sandler





Christopher Hoover Hardware Engineering

Former lead of Google AR/VR hardware and Hardware Lead at Google Geo Google The Moonshot Factory





1. Making it easier for vehicles and people to see the road ahead

Talking to vehicles and people to provide deeper insights about the complex roadway operating environment, including events appening ahead Simplifying the road operating environment for vehicles and

eople



2. Talking to vehicles and people to provide deeper insights about the complex roadway operating environment, including events happening ahead

Simplifying the road operating environment for vehicles and



Making it easier for vehicles and people to see the road ahead Talking to vehicles and people to provide deeper insights about ecomplex roadway operating environment, including events appening ahead

happening ahead

3. Simplifying the road operating environment for vehicles and people



Cavnue can add value among numerous users

Dedicated and / or mixed use lanes for autonomous trucks, autonomous transit, and passenger AVs

Digital twin to improve road operations and maintenance



Trucking

Improves safety

Improves quality of driver experience to help address driver shortage

Reduces shipping costs

Additional savings via battery electric fleet integration



Transit

Improves safety, which reduces operating costs

Enhances fleet management and planning

Improves reliability

Provides equitable access to autonomy

Passenger

Improves safety

Increases throughput

and time savings

Provides value of

autonomy to

passengers

Creates opportunity

for future integration

with EV charging

TAT

Operations

Digitizes traffic monitoring and management

Increases responsiveness to accidents

Reduces operating expenses

Minimizes revenue leakage



Maintenance

Increases responsiveness to maintenance needs

> Reduces maintenance expenses

Transforms MoT capabilities

Michigan Project



Project Overview: Highway CAV lane + boulevard test

Project overview: Michigan CAV Corridor from Detroit to Ann Arbor



Project status

Stage

Initial Discussions

Feasibility Analysis

Execution

Key counterparties

ČMDOT

Announced flagship project with key partners in government and private sector

-bed





Next steps

Expect to (i) deploy sensors by Q4 2021, (ii) refine the demand model and business case, (iii) conduct public outreach, and (iv) refine designs – all in service of long-term commercial agreement with MDOT by end of 2021.

Potential of I -35 and Minnesota

Potential of Interstate 35

- Develop technology to address challenging weather conditions
- Potential to integrate with existing managed lanes on I-35E/I-35W
- Improving safety and efficiency of transit on the corridor
- Potential freight connections to Duluth port
- Lessons learned from I-35 Snowplow activation
- Developing first multi-state CAV corridor





MINNESOTA CAV UPDATES

KRISTIN WHITE CAV-X EXECUTIVE DIRECTOR

CORY JOHNSON CAV-X TECHNICAL PROGRAM MANAGER

THOMAS JOHNSON-KAISER CAV-X ENGAGEMENT AND PROJECT MANAGER



MEET THE MED CITY MOVER

Discover the future of transportation in Rochester, MN





PROJECTBACKGROUND

MnDOT CAV Challenge Program Two Level 4 automated shuttles

- Onboard ambassador
- **Urban route**
- Open to the public
- 12 months of operation

Delayed due to COVID9 pandemic impacts







PROJECTGOALS



Engage Minnesotans about the potential benefits and opportunities of this technology



Improve how automated vehicles drive and function in winter weather conditions



Identify changes to infrastructure needed to safely operate automated vehicles on public roads

Enhance the transportation experience for Rochester residents, businesses and visitors and improve how people get around in the highdemand downtown area















HIGHWAY 52 CAV CORRIDOR PLANNING

Project Goals

- Develop partnerships
- Understand CAV technologies
- Select technology applications
- Advance safety, equity, accessibility, mobility, and sustainability on Highway 52





HIGHWAY 52 CORRIDOR CHALLENGES

STAKEHOLDER FEEDBACK

What are your top hallenges this project should address?







RECOMMENDED APPLICATIONS

- Intelligent Work Zones
 - 1. Real-time information sharing
 - 2. Queue warning system enhancements
- Hazard Warning Systems
 - 3. Law enforcement
 - 4. Weather
 - 5. Vehicle on shoulder
- Traveler Information
 - 6. Alternate route advisories
 - 7. Data fusion and integration
 - 8. Special purpose data portals











HIGHWAY 52 CORRIDOR NEXT STEPS Potential vehicle detection applications



Testing & Pilots

DEPARTMENT OF TRANSPORTATION



CAV TRAVELER ALERT SYSTEM

GOALS

- Improve safety of roadway users and workers by informing motorists of maintenance and snowplow vehicles in their paths of travel
- Communicate vehicle proximity information to motorists' smartphones in selected situations

PROJECT STATUS

- Testing completed by MnDOT Maintenance staff
- Next step is public outreach



CAV Challenge proposal & project architecture





SNOWPLOW LANE KEEPING ASSIST

BACKGROUND

• Lane keeping system developed by the University of Minnesota to support plow operators when visibility is poor

OBJECTIVES

- Improve plow efficiency by allowing operators to maintain a desired path under poor visibility conditions
- Design and develop a forward-looking hazard detection system
- Reduce system cost and improve system



Challenging white out conditions





PROPOSED PLOW ROUTES



Winter 2020-2021

- 4 plows across Minnesota
- Evaluated systems strengths and limitations and gathered user feedback

Winter 2021-2022

- All MnDOTDistricts and Dakota County have plow with upgraded system
- Gathering additional feedback from users



OTHER RECENT CAV & ITS PROJECTS



Twin Cities Startup Week Autonomous Truck Mounted Attenuator (ATMA) Testing CAV Career Pathways Camp





NATIONAL COORDINATION

A National strategy and vision are needed.

cludes a vision and CAV deployment readiness strateg

olicy statement: AASHTO supports the need for a coordinated National Strategy which

8

AASHO

AASHTO CAV Policy Principles

AASHTO Connected and Automated Vehicle

Policy Principles

put from 100s, inrs. representing the

ernational models n lead these efforts pplications for pub-

prove the safety ively advance CAV

for all users

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lectric vehicle technol / goals, sustainability

ric vehicles technol

3

nd the appropriate

ITS 💐 AMERICA

Automated Vehicle Standing Advisory Committee

Equity, Climate, Safety, and Infrastructure Principles for Automated and Autonomous Mobility September 13, 2021

Introduction

More than 38,000 people died on US roads in 2020. Our cities, the engine of the U.S. economy, are rewing once again, leading to increased cogresion. Interstates divide our communities. The transportation sector is responsible for 27 percent of the country's gueenhouse gas emissions. Our highways and bridges, built largely between the mi-L1950s to 1070s, are crumbling and strugging to more goods and people with the efficiency required by the technolog-whene poble accompt.

Twenty-one years into the 21st century, automated and autonomous vehicles (AVs) present us with a generational opportunity to reimagine our transportation system and transform outcomes – saving tens of thousands of people, reducing greenhouse gas emissions and congestion, and leading to more vibrant, equitable places.

Critical to achieving this future is the federal government putting in place national regulatory frameworks and investments for the physical and digital infrastructure with developers of AV lechnology around rease such as equity, climate safety, and intelligent infrastructure, as the lechnologn moves from expanded pilots to full deployment of AV fleets. AVs present significant opportunities to expand mobility for people who currently have limited transportation options and increase access to mobility more broady.

ITS America's Automated Vehicle Standing Advisory Committee established task forces on equity, climate, safety, and infrastructure to develop a set of principies to ensure AV benefits are broadly realized. The resulting principles are intended to inform federal programs, regulations, and recommend best practices that can be implemented today and in the future.

Principle Recommendations

Improving Transportation Safety

1. Laying the groundwork for the transformation of our nation's transportation systems and

ITS America policy work AASHTO Guiding Principles



Midwest CAV coordination

Pooled Fund Studies



- AV freight & platooning
- Connected vehicles
- AV roadmaps
- Mobility on demand
- AV maintenance

DEPARTMENT OF TRANSPORTATION



OPPORTUNITY FOR PUBLIC COMMENT

Please enter use 'raise hand' feature or type your question into the chat box



UPCOMING EVENTS

- Mobility Fair Rochester, September 16th from 1-6 PM
- Twin Cities Startup Week University Enterprise Labs, St. Paul, September 20th from 8-5
- ITS Minnesota Fall Forum September 28-30th Online from 9-12:30 PM
- Med City Mover Public Kickoff September 30th in Rochester at 11:30 AM
- Next Council Meeting December 8th from 10-12:30 (Invitation Forthcoming)

CLOSING

Margaret Anderson Kelliher, Co-Chair Commissioner, MnDOT

Phil Magney, Co-Chair CEO and Founder, VSI Labs

Next meeting December 8, 2021



THANK YOU

GOVERNOR'S COUNCIL ON CONNECTED AND AUTOMATED VEHICLES

MARGARET ANDERSON-KELLIHER Co-Chair PHIL MAGNEY Co- Chair



