

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



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AGENDA

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



COUNCIL MEMBERS

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

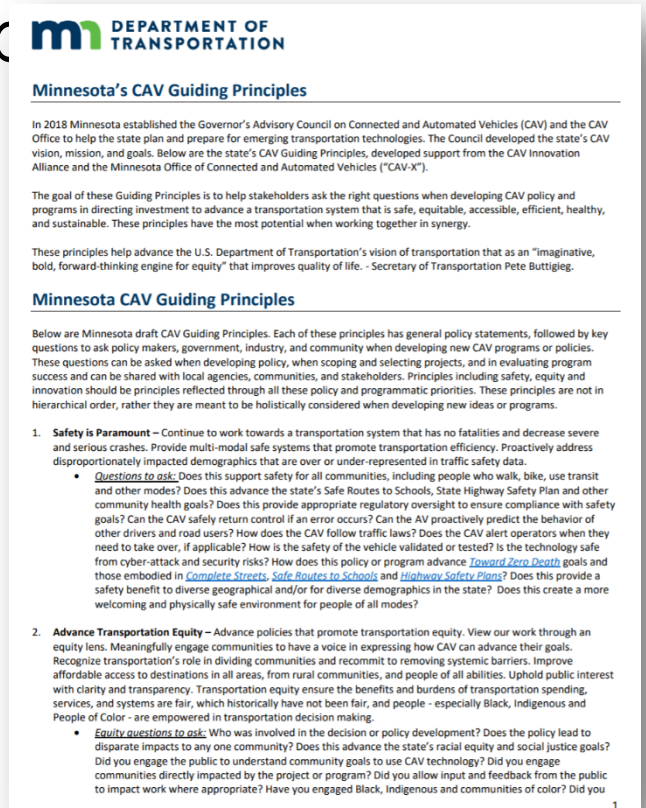
OTHER PARTICIPANTS

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 Principles
- 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



CAV Guiding Principles

CAVNUE

TYLER DUVALL, CEO OF CAVNUE

GOAL: LEARN ABOUT CAVNUE'S
INFRASTRUCTURE INVESTMENT MODEL





cavnue

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 ”

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

Congestion



” MnDOT says that statewide, traffic volumes have returned to normal² ”

Freight



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

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

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 fast⁵ ”



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



OEM	Intro year	Models ¹ , #	Examples	Est. sales volume, K		Headlines
				2020	2023	
General Motors <i>Super Cruise</i>	2020	22	• Cadillac Lyriq • Buick Encore	37.6	177.3	“ GM's Super Cruise Self-Driving Tech Will Be on 22 Vehicles by 2023 CAR & DRIVER Feb 2021
Ford <i>BlueCruise</i>	2020	11	• Mustang Mach-E • F-150 SuperCrew	3.7	52.7	
Tesla <i>Autopilot</i>	2020	5	• Model X • Model 3	153.5	302	“ Tesla Full Self-Driving subscription model coming in Q2 2021 ROAD & SHOW Mar 2021
Volvo <i>Pilot Assist</i>	2023	2	• Volvo XC90 • Volvo XC100	0	7.6	
Volkswagen <i>Traffic Jam Assist</i>	2020	12	• Volkswagen Atlas • Audi A4	27.4	52.1	
Nissan <i>ProPilot Assist 2.0</i>	2021	2	• Infiniti QX50 • Infiniti QX55	0	5.5	
Toyota <i>SafetySense 2.5</i>	2021	46	• Toyota Camry • Lexus LX	0	421.6	“ 2021 Toyota Camry is first to get Safety Sense 2.5 Plus ROAD & SHOW Jul 2020

¹ Estimated based on public announcements

Road infrastructure isn't keeping up with vehicle technology

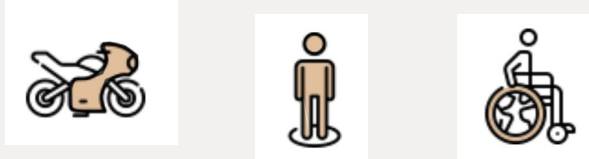


The more test -miles OEMs accrue, the more they understand how much complexity they still can't account for

Initial problem formulation

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

+Unpredictable road actors



+Unpredictable infrastructure



Hundreds of thousands of intractable edge cases

+Unpredictable environment



Supportive infrastructure can radically simplify the complexity problem

Simplify

Sense + See

Inform + Coordinate

Permit + Penalize



cavnue

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



Cavnue Team



Tyler Duvall
Chief Executive Officer

Nationally recognized leader in transportation

McKinsey
& Company



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



US DOT
FHWA



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



Dino Nardicchio
Automotive & AV Partnerships

Former Global VP of R&D Magna International



Pete Kenny
General Counsel

Former multi-vertical legal lead at HP and VP/DGC at Perspecta



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



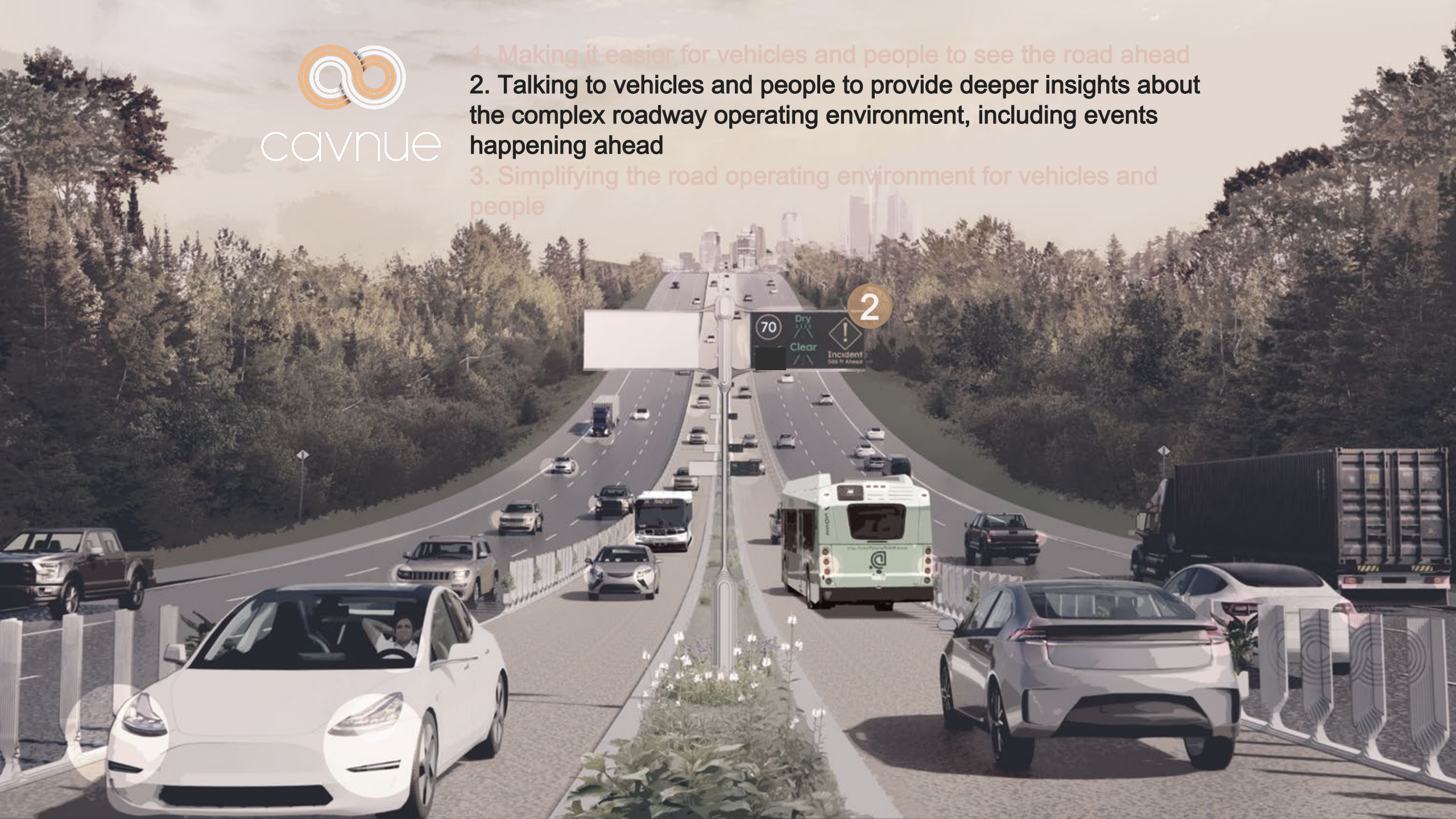


1. Making it easier for vehicles and people to see the road ahead
2. Talking to vehicles and people to provide deeper insights about the complex roadway operating environment, including events happening ahead
3. Simplifying the road operating environment for vehicles and people





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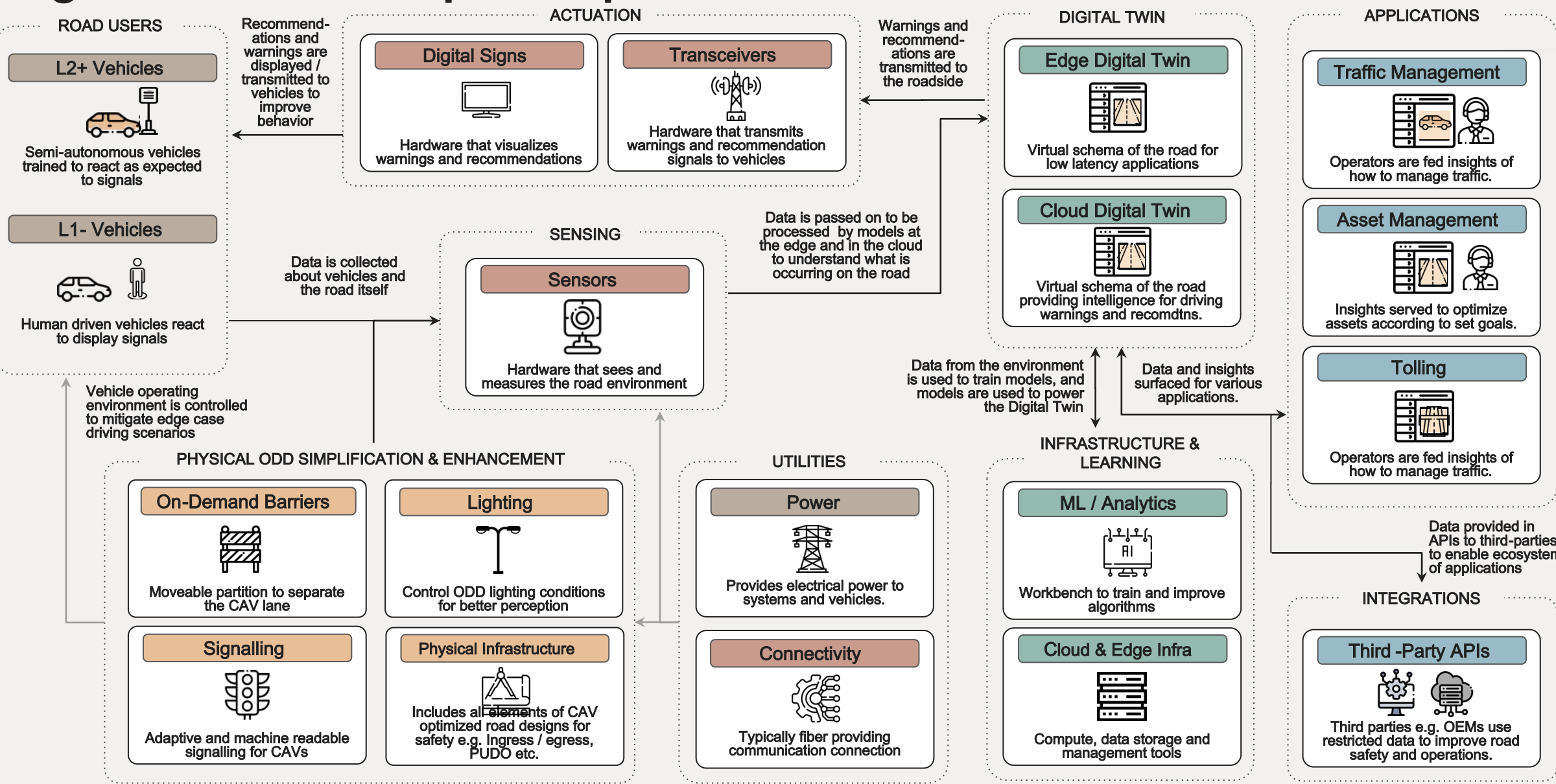
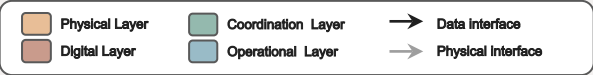




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Digital Twin Concept of Operations



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



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

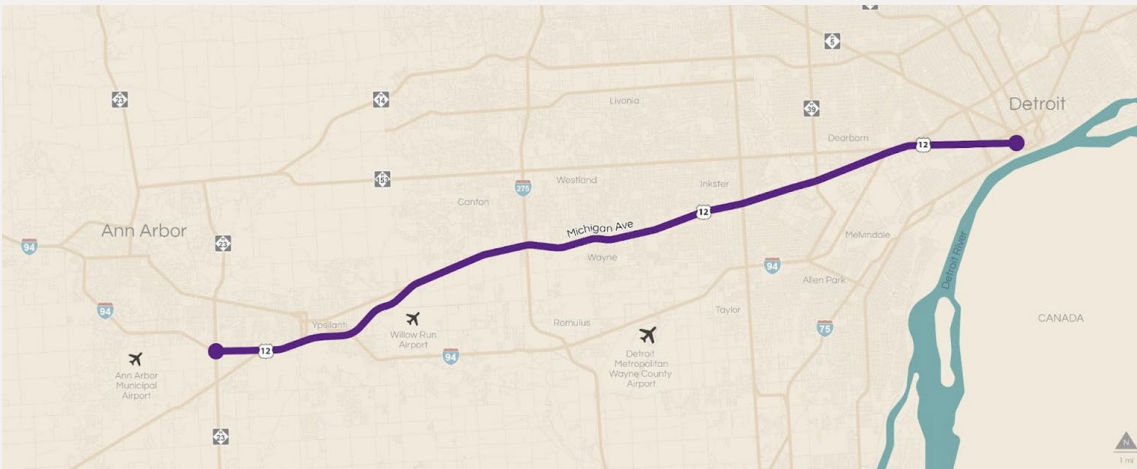
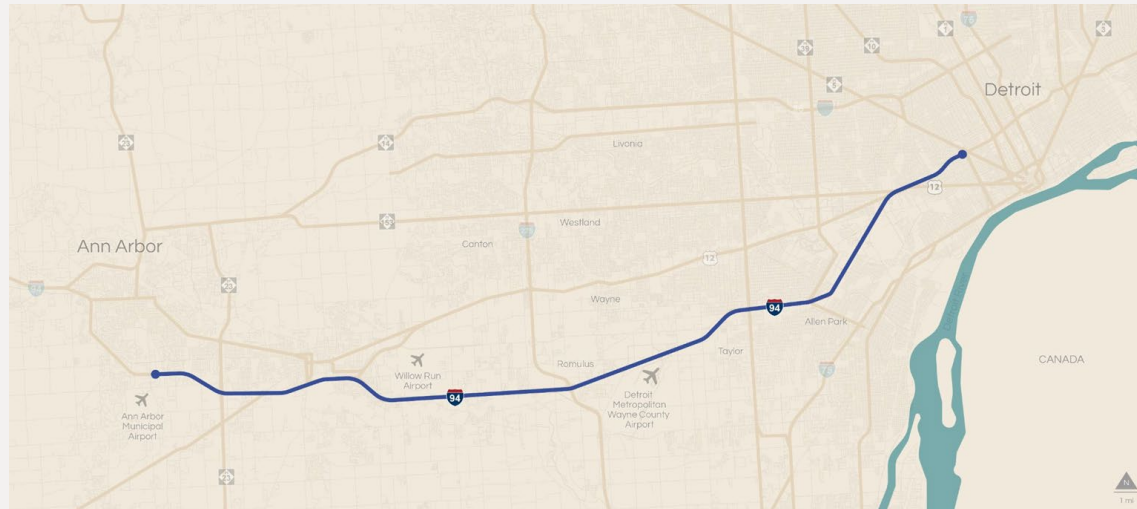
Michigan Project



Project Overview: Highway CAV lane + boulevard test -bed



Project overview: Michigan CAV Corridor from Detroit to Ann Arbor



Project status

Stage

Initial Discussions

Feasibility Analysis

Execution

Announced flagship project with key partners in government and private sector



Gretchen Whitmer |
Governor, Michigan



Bill Ford |
Executive
Chairman, Ford

Key counterparties



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.

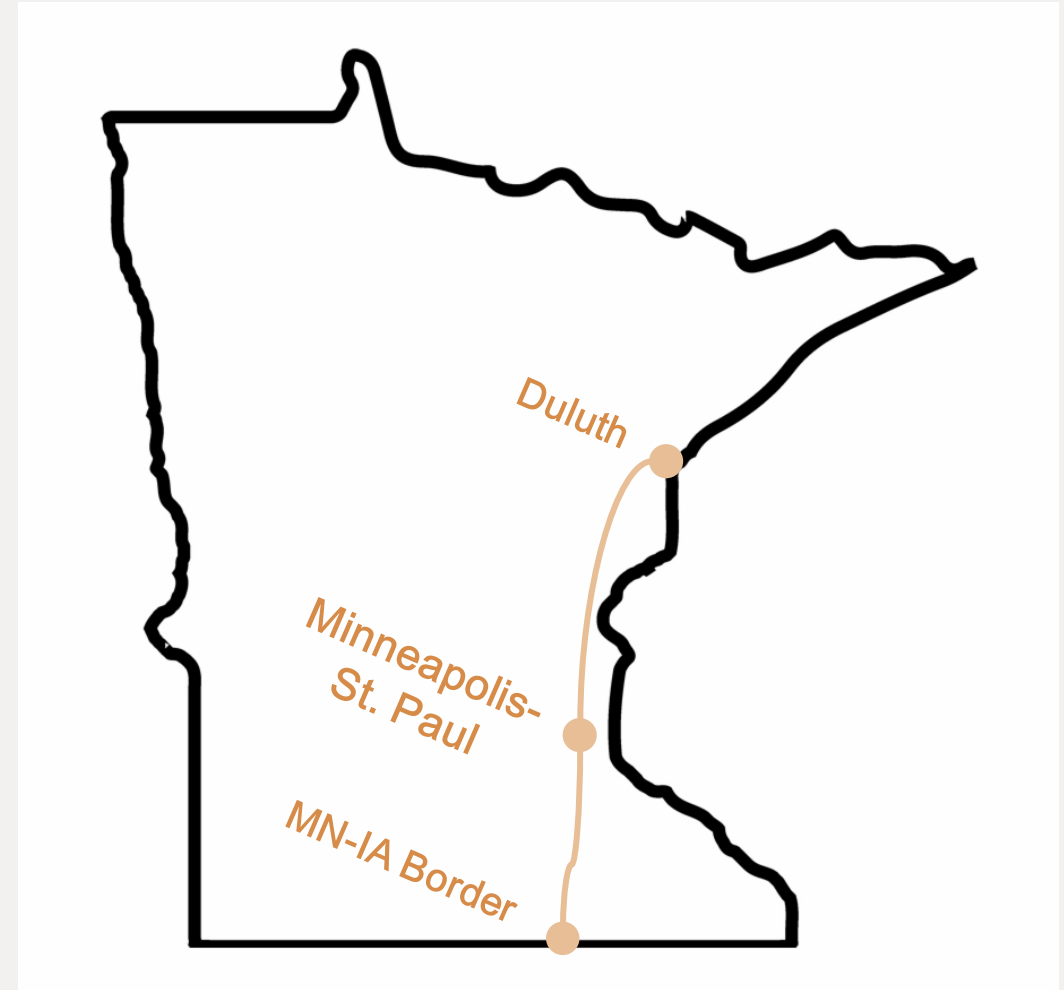
Potential of I -35 and Minnesota



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



// PROJECT BACKGROUND

- MnDOT CAV Challenge Program
- Two Level 4 automated shuttles
 - 👤 Onboard ambassador
 - 🏠 Urban route
 - ➡ Open to the public
 - 🕒 12 months of operation
- Delayed due to COVID-19 pandemic impacts



// PROJECT GOALS



Engage Minnesotans about the potential benefits and opportunities of this technology



Improve how automated vehicles drive and function in winter weather conditions

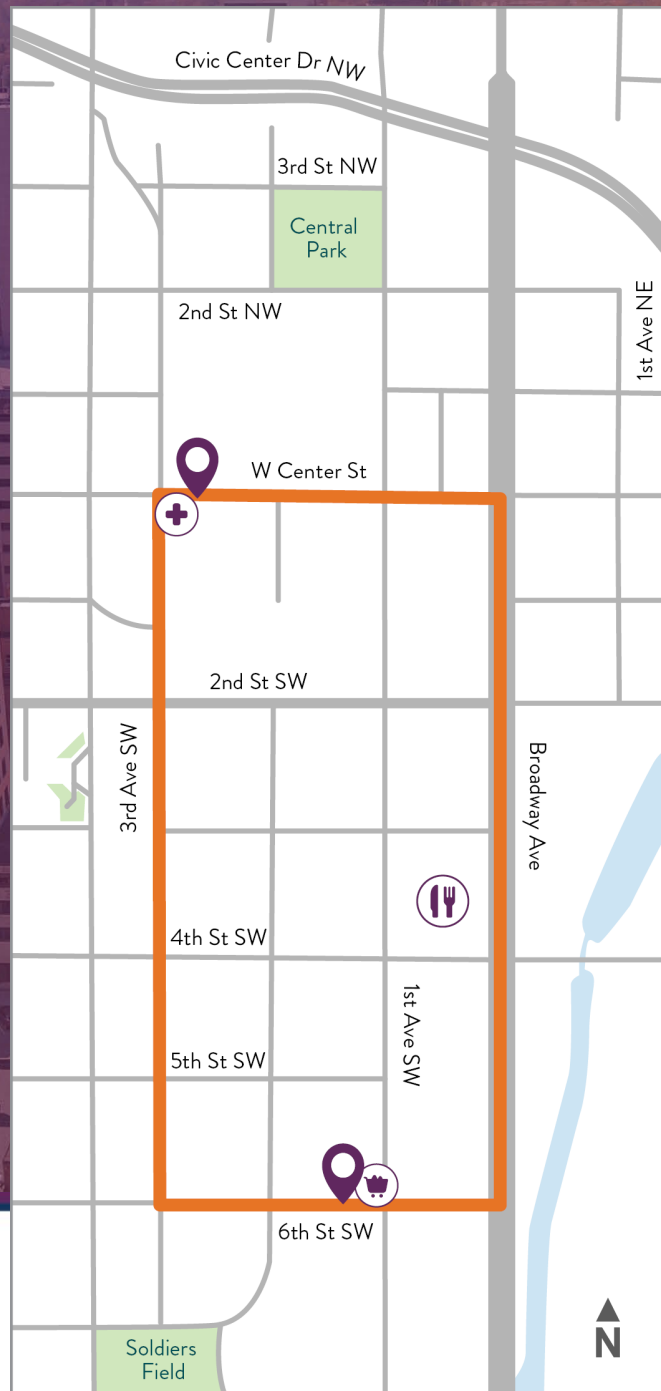


Identify changes to infrastructure needed to safely operate automated vehicles on public roads



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

SHUTTLE ROUTE



LEGEND

 Shuttle route

 Shuttle stop

 Mayo Clinic area

 Restaurant area

 Grocery stores

HIGHWAY 52 CAV CORRIDOR PLANNING

Project Goals

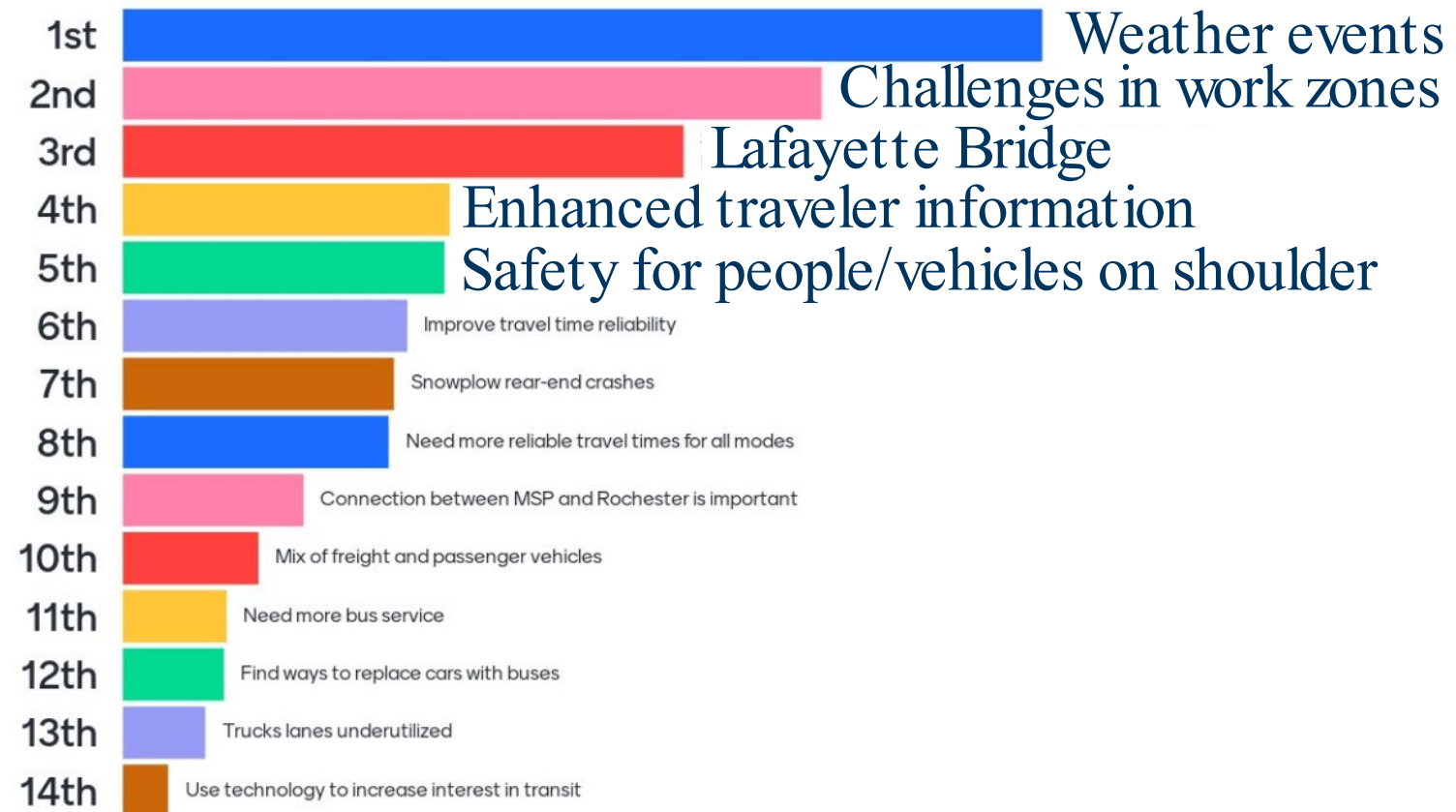
- Develop partnerships
- Understand CAV technologies
- Select technology applications
- Advance safety, equity, accessibility, mobility, and sustainability on Highway 52



HIGHWAY 52 CORRIDOR CHALLENGES

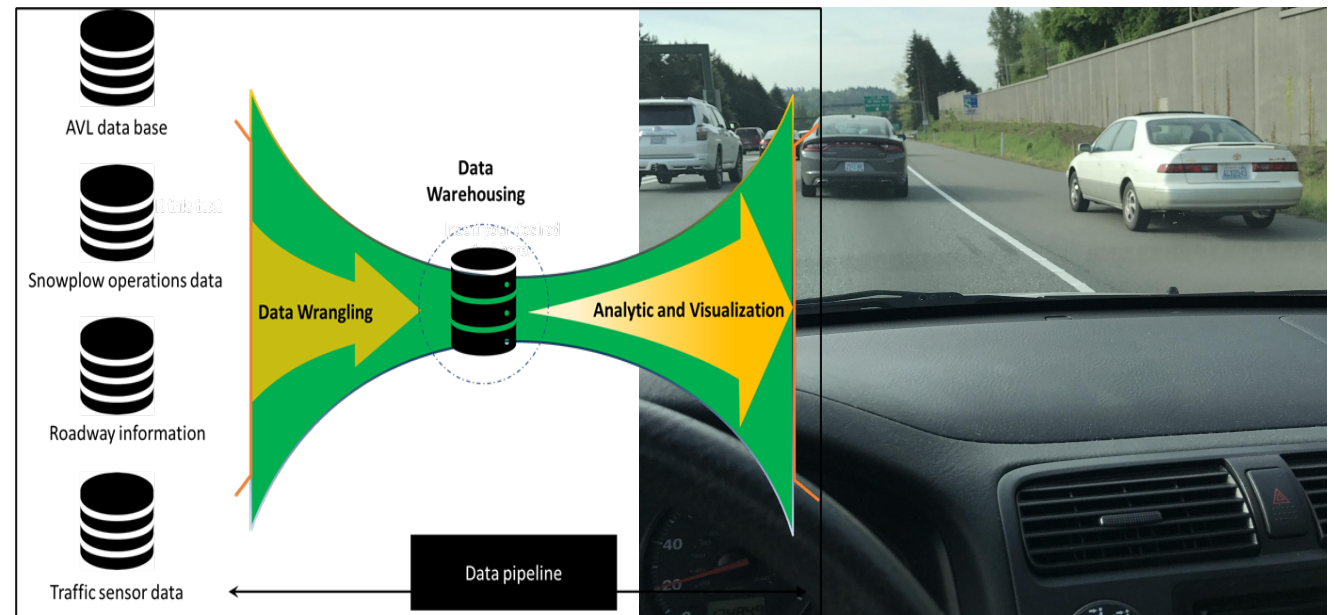
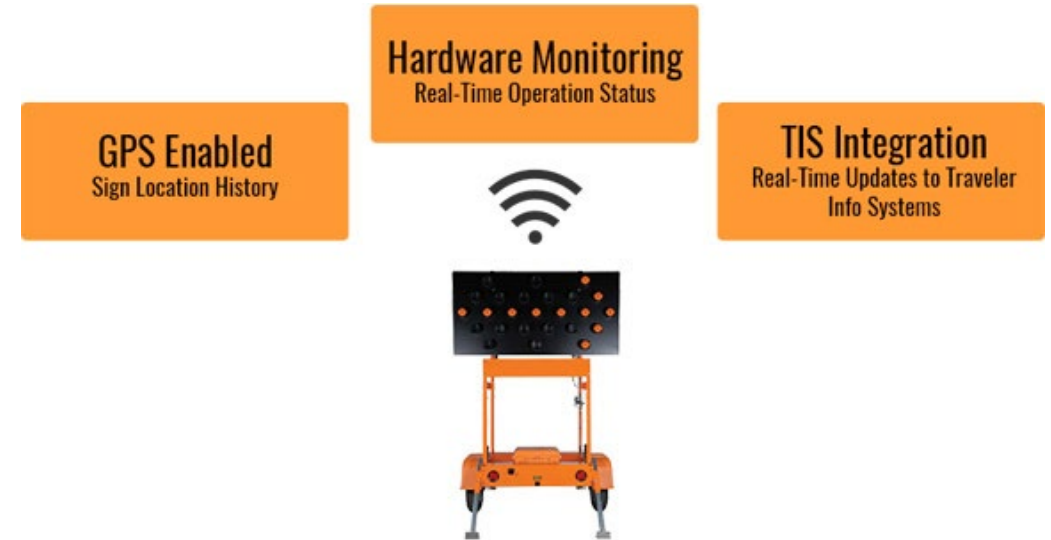
STAKEHOLDER FEEDBACK

What are your top challenges this project should address?

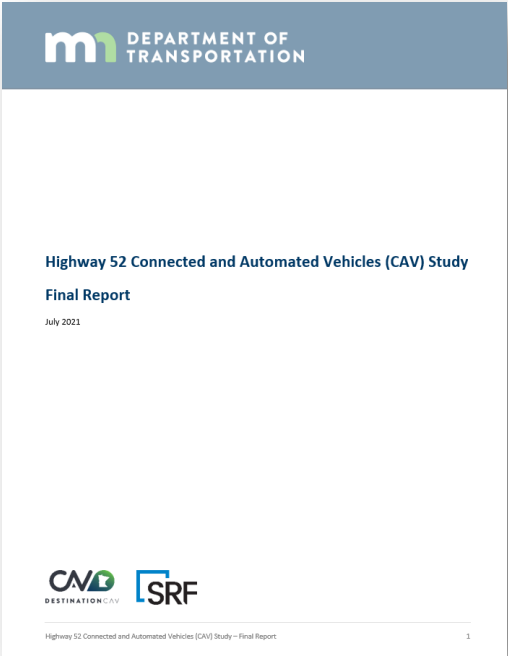


RECOMMENDED APPLICATIONS

- **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



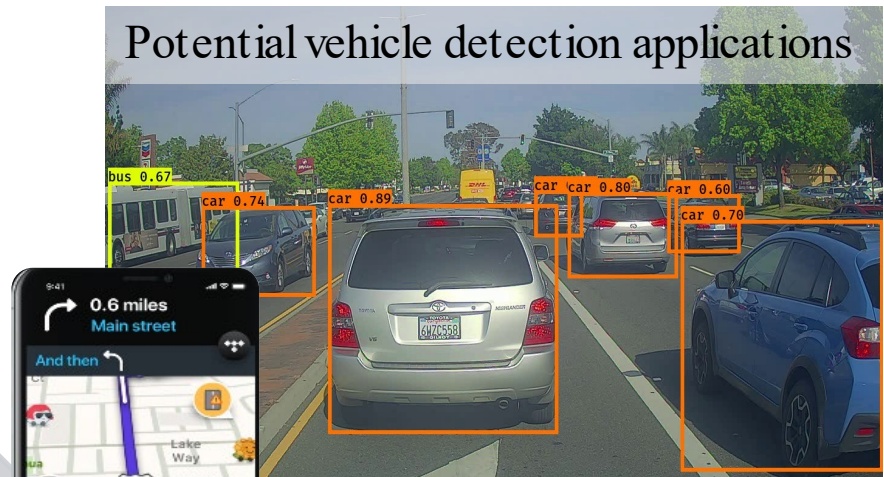
HIGHWAY 52 CORRIDOR NEXT STEPS



Highway 52 CAV Study

- Seek CAV Challenge proposals
- Integrate with existing projects
- Issue an RFP

Potential vehicle detection applications



Potential in-vehicle display

Testing & Pilots

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



SNOWPLOW LANE KEEPING ASSIST

BACKGROUND

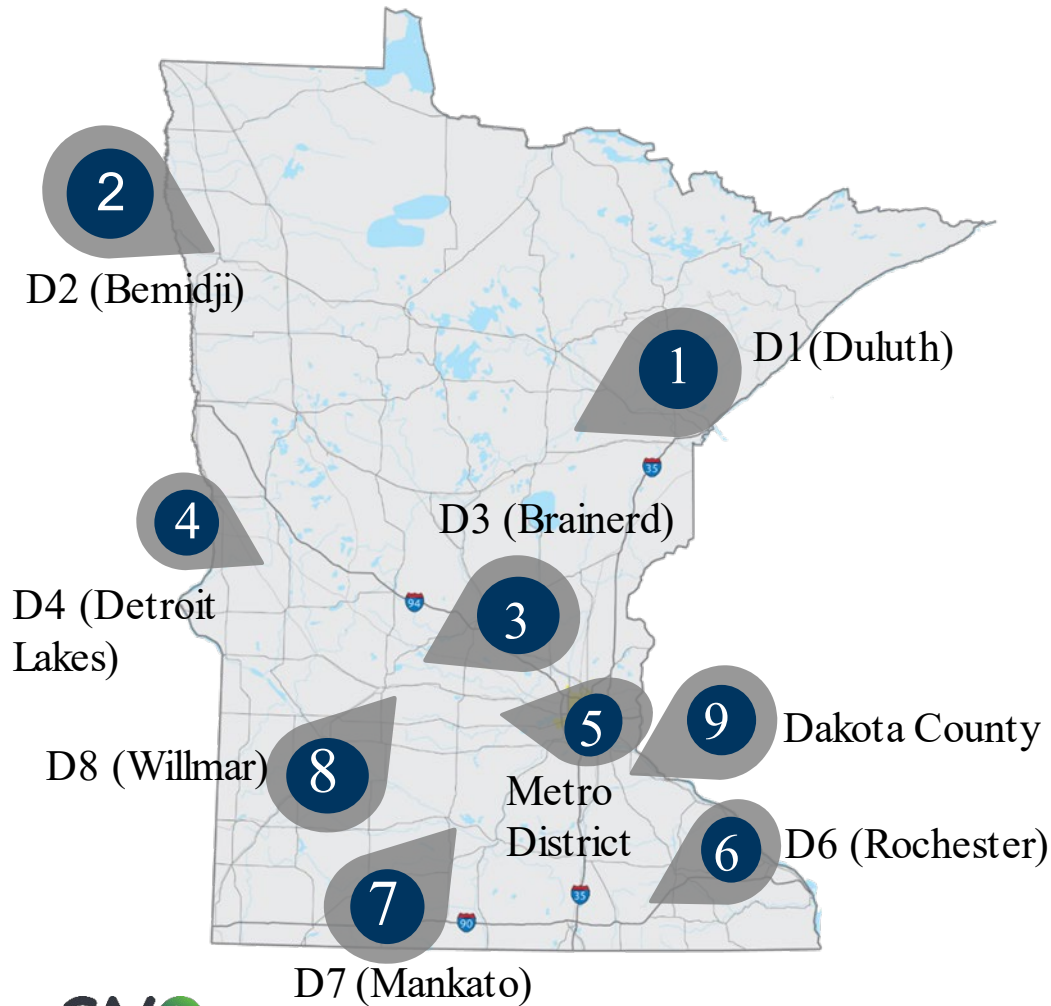
- Lane keeping system developed by the University of Minnesota to support plow operators when visibility is poor

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



PROPOSED PLOW ROUTES



Winter 2020-2021

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

Winter 2021-2022

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

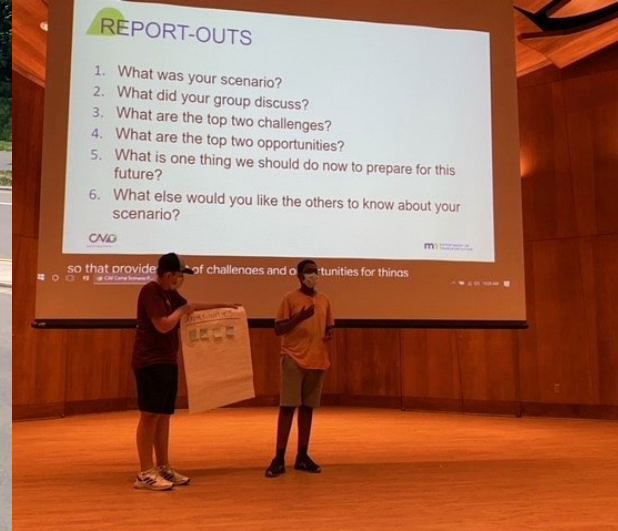
OTHER RECENT CAV & ITS PROJECTS



Twin Cities
Startup Week

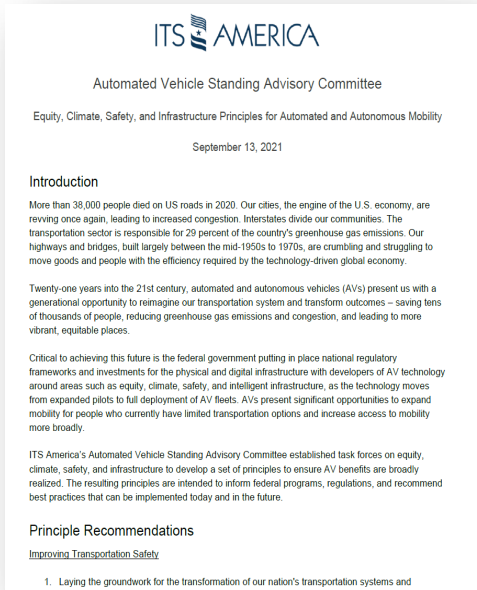


Autonomous Truck Mounted
Attenuator (ATMA) Testing

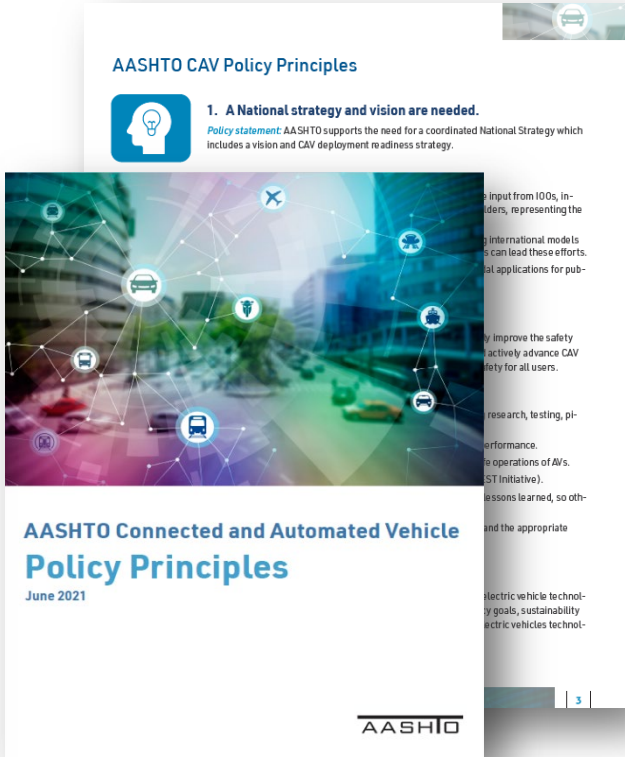


CAV Career
Pathways Camp

NATIONAL COORDINATION



ITS America policy work

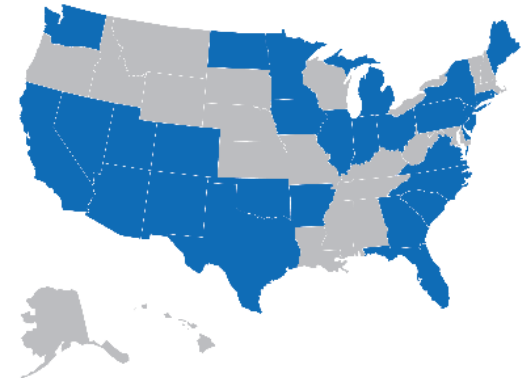


AASHTO Guiding Principles



Midwest CAV coordination

Pooled Fund Studies



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

OPPORTUNITY FOR PUBLIC COMMENT

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

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4

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



5

THANK YOU

GOVERNOR'S COUNCIL ON CONNECTED AND AUTOMATED VEHICLES

MARGARET ANDERSON-KELLIHER
Co-Chair

PHIL MAGNEY
Co-Chair

