WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State Transportation Commission

AV Work Group Executive Committee Meeting

October 5, 2021

Washington State Transportation Commission

Agenda

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

TIME	DESCRIPTION	PRESENTER
9:00	**Welcome, Introductions, & Virtual Meeting Operations**	**Jim Restucci**, Chair, *AV Work Group Executive Committee*
9:10	**Minnesota Connected and Automated Vehicles (CAV) Challenge**	**Tara Olds**, Deputy Director, CAV-X Program, *Minnesota Department of Transportation*
9:40	**AV Pilot Considerations**	**Scott Shogan**, Vice President, *WSP USA*
10:00	**Michigan Connected and Automated Vehicles (CAV) Corridor**	**Mark de la Vergne**, VP Project Development, *Cavnue*
10:40	**AV Work Group Roadmap to the Future Development Update**	**Scott Shogan**, Vice President, *WSP USA*
11:00	**AV Subcommittee Updates & Recommendations**	**Beau Perschbacher**, co-chair, *Licensing Subcommittee* **Captain Dennis Bosman and Manuela Papadopol**, co-chairs, *Safety Subcommittee* **David Forte**, co-chair, *Liability Subcommittee* **Zack Hudgins**, co-chair, *System Technology & Data Security Subcommittee* **Dr. Andrew Dannenberg**, chair, *Health & Equity Subcommittee* **Allison Drake**, co-chair, *Workforce Subcommittee*
11:30	***LUNCH BREAK***	***30 MINUTES***
12:00	**AV Industry Panel**	**Nick Greif**, Senior Manager, *Public Policy, Motional* **Manuela Papadopol**, CEO, *Designated Driver*
12:45	**Executive Committee Member Items**	*Open forum for members*
1:00	**NHTSA National AV Update**	**Dr. Steven Cliff**, Acting Administrator, *National Highway Traffic Safety Administration (NHTSA)*
1:30	**GHSA Report: Law Enforcement, First Responder, and Crash Investigation Preparation for Automated Vehicle Technology**	**Tammy Trimble**, Senior Research Associate, *Virginia Tech Transportation Institute*
--	**Closing Remarks**	**Jim Restucci**, Chair, *AV Work Group Executive Committee*
2:00	**ADJOURN**	

Overview of Virtual Meeting Operations

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission

Virtual Meeting Operations – Zoom Webinar

Executive Committee Members & Presenters

- You have the ability to **mute/unmute yourself**, please stay on mute unless wishing to speak
- You are encouraged to **turn on your video**, especially during discussion periods
- You can **use the "Chat" box** to communicate with "panelists" - meeting hosts, committee members, and presenters
  - » NOTE: You do have the ability to send a chat to ALL ATTENDEES, *please do not use this feature*

The meeting controls bar may be on top, bottom, or sides of your screen

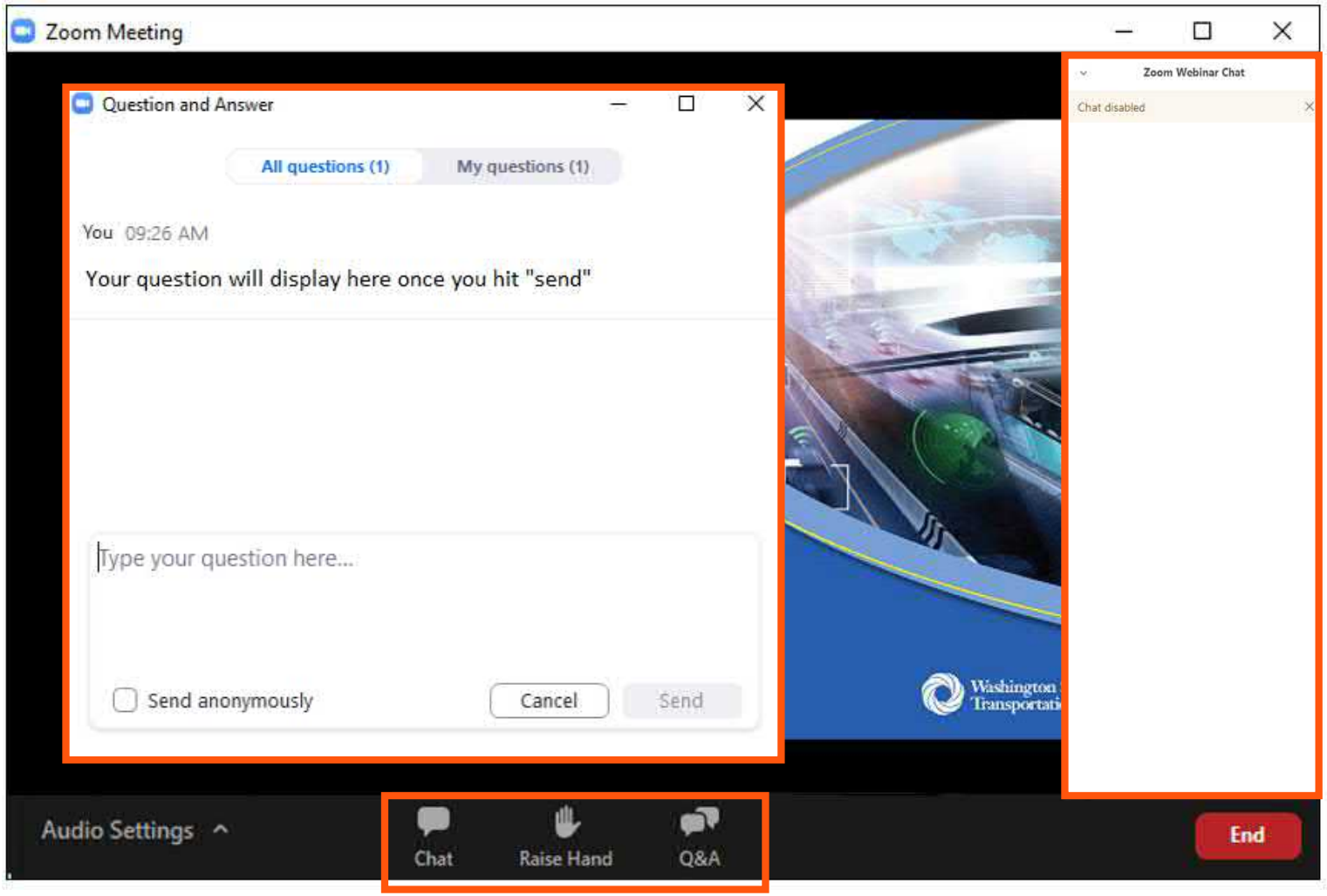
Virtual Meeting Operations – Zoom Webinar

Executive Committee Members & Presenters

(continued)

- During discussion and Q&A periods:
  - Physically **raise your hand on your video**
  - OR
  - Pose a question in the **"Chat" box**
  - *Note you will not have the "Raise Hand" feature*
- You will be able to see questions in the Q&A box, but may not be able to pose a question – please physically raise your hand or use the "Chat" feature

Virtual Meeting Operations – Zoom Webinar



Other Attendees

- You will be **muted with no video capabilities** when you join
- The “Chat” feature is disabled
- **Use the “Raise Hand” feature** to request to be unmuted
- You can **use the “Q&A” box** to pose questions
  - » Organizers will read questions aloud during the Q&A period of each presentation

Virtual Meeting Operations – Zoom Webinar

Other Attendees

- Call-in participants **can still access the Q&A box,** if viewing the presentation online
- For those only calling in, you can **mute/unmute by pressing *6**
  - » When not speaking, please ensure phone line is muted
- For those only calling in, you can **“Raise Hand” by pressing *9**

Minnesota Connected and Automated Vehicles (CAV) Challenge

Tara Olds, *Minnesota Department of Transportation*

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission

OCTOBER 2021

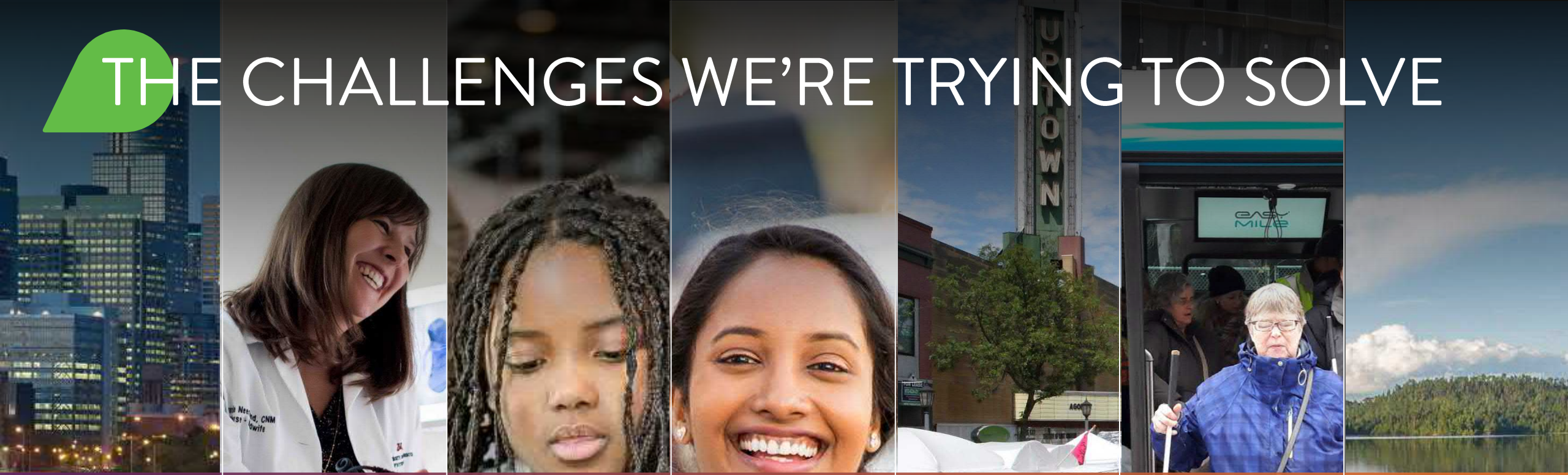
MINNESOTA CAV CHALLENGE: HOW "MINNOVATION" INSPIRED VALUES-BASED PARTNERSHIPS

Minnesota Office of Connected and Automated Vehicles

DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION

THE CHALLENGES WE'RE TRYING TO SOLVE



ECONOMY | HEALTH | EDUCATION | HAPPINESS | COMMUNITY | EQUITY | ENVIRONMENT

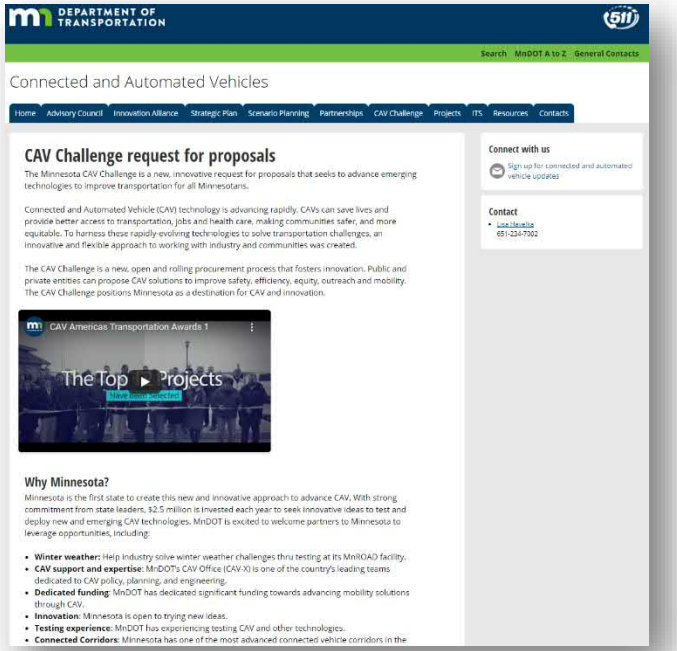
CAVD DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION

BACKGROUND

- Launched in October 2018 and resulted in 16 awards and 7 fully-negotiated contracts
- Winner of the 2019 National Cronin Award for Procurement Excellence, the 2020 AASHTO Innovation Award and the 2021 WTS Innovation Award
- Notable projects include Rochester autonomous shuttle pilot, fiber optic feasibility study, Smart Snelling connected vehicle corridor, and autonomous trucks
- Partnering with new entities: economic development, IT, counties, medical centers, cities, tech industry and new voices in innovation
- Saved $2M+ in RFP resources and 200+ hours of staff time

CAV Challenge website
www.mndot.gov/automated/cavchallenge



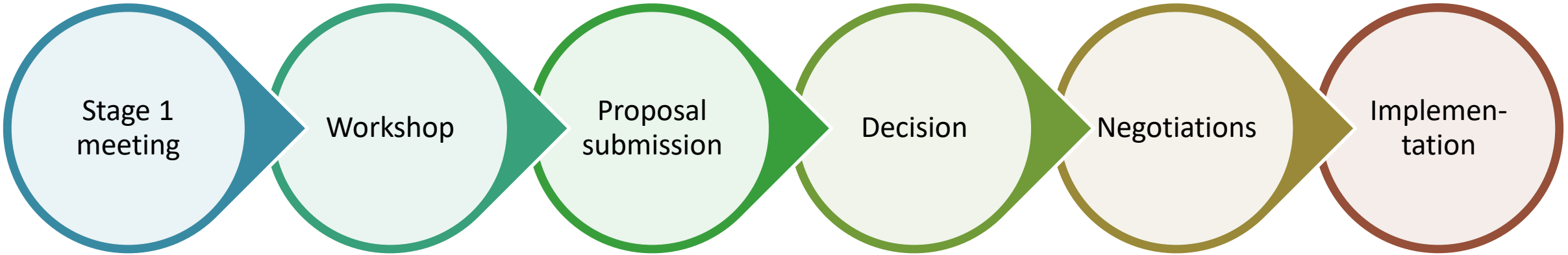
DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION

BENEFITS AND OPPORTUNITIES

- RFP open for an indefinite amount of time (open, rolling)
- Open to wide variety of CAV solutions
- Ability to talk with vendors
- Protect trade secrets
- Contract with partners that meet our goals
- Hear from new and unique voices and industries
- Fair and open competition
- Consistent requirements for vendors
- Rules and guidelines are clear to vendors
- Subjective and objective criteria
- Systematic approach to vendor selection
- Proposals evaluated against documented goals in RFP
- Same team scores all proposals
- Technical experts evaluate proposals within their field of expertise

PROCUREMENT PROCESS



- Ideation
- Goals
- Brainstorming

- Refine concept
- Hear from technical experts

- Fund
- Hold for future funding
- Reject & debrief

- Legal terms
- Scope
- Schedule
- Budget
- Risk

- Iteration
- Evaluation
- Engagement
- Systems analysis

WHEN TO USE CHALLENGE-BASED RFPS

- Ideas seeking new outside partners
- Flexible timelines; not urgent
- Open to ideation and brainstorming
- You can pose a problem to solve or define broad goals for vendors to meet
- Requirements are:
  - Unknown
  - Hard to define
  - Rapidly changing
- Innovation

WHAT WE HEARD FROM PARTICIPANTS

- Really like the ability to speak confidentially
- Use workshops to brainstorm ideas and hear reactions from technical experts
- Make the process crystal clear
- Leverage the virtual environment for online meetings, tools, and proposal submissions
- Make the decision process, timelines and criteria clear
- Clearly state your goals and prioritize them in the RFP

Example showing how project goals match with Minnesota goals

CAV Goal	Project Deliverable	How Deliverable Meets CAV Goal
CAV Strategic Plan Recommendation 58 – Conduct public demonstrations throughout Minnesota	1 Level 4 AV demonstration held in Northern Minnesota for 1 week	Public will have the ability to interact with technology.

Risk assessment and strategy example

Risk Category	Description	Likelihood	Owner	Mitigation Strategy
Safety	Vehicle technology may not work properly and may stop abruptly	Medium	Applicant, technology sub-consultant	Develop safety plan and emergency communications plan

MINNESOTA CAV CHALLENGE

HAVE AN IDEA? REQUEST A MEETING TO ADVANCE A COMMUNITY PARTNERSHIP

GEORGE CRONIN ★ awards for ★ Procurement Excellence™

103
VENDOR MEETINGS

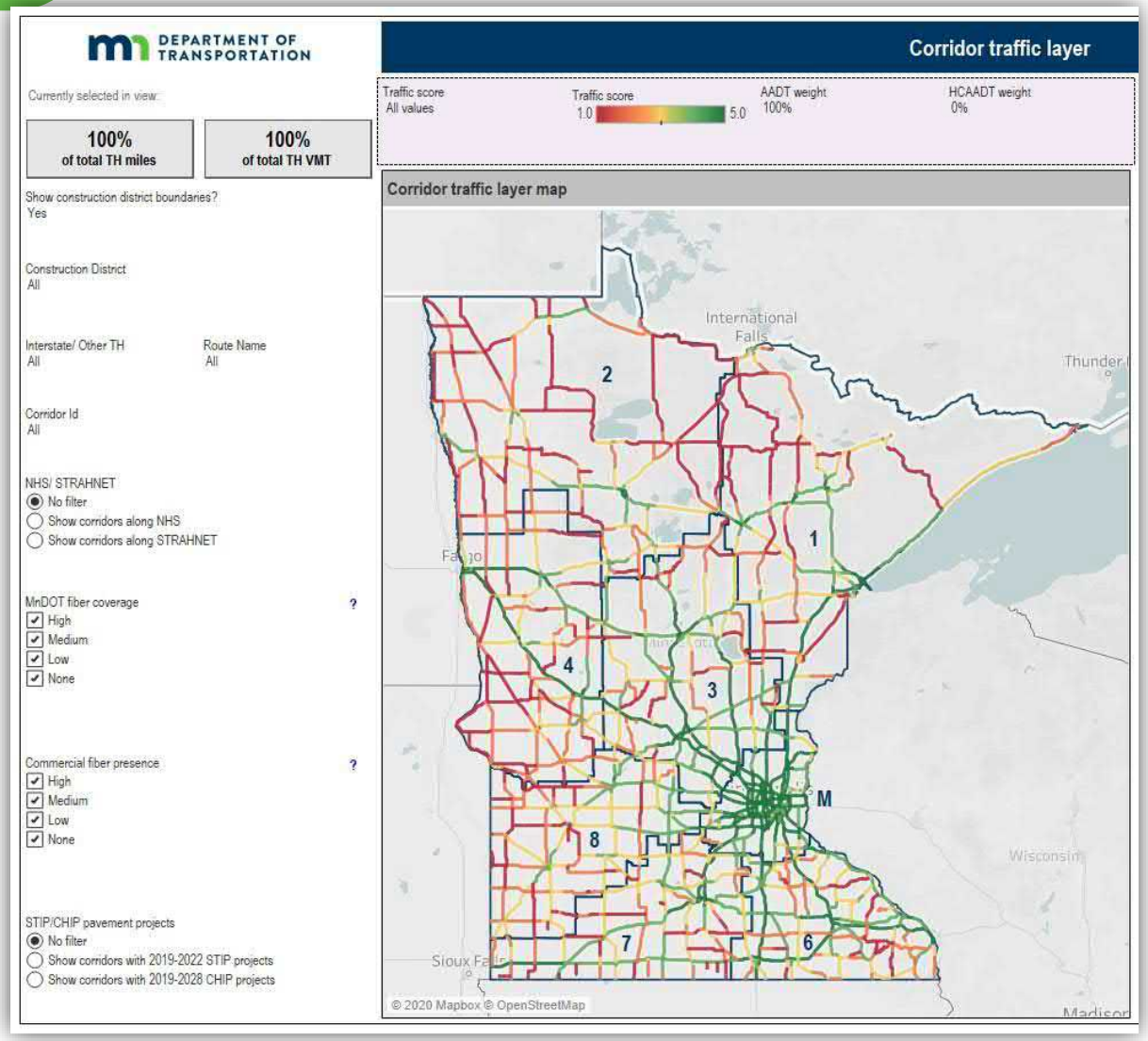
69
PROPOSALS SUBMITTED

16
AWARDED PROJECTS

DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION

FIBER OPTIC STUDY & PARTNERSHIP



GIS overview of Minnesota traffic volumes

Traffic layer - Daily traffic volumes to prioritize investment where most traffic is

Opportunity layer –Connect state assets (cameras, buildings, signals, traffic data collectors) to prioritize corridors that connect cameras, sensors and buildings.

Commercial layer – Shows private sector plans to build to prioritize investment based on private interest.

Combined – Shows all the layers to prioritize different corridors.

AUTONOMOUS MAINTENANCE

SELF-DRIVING TRUCKS WITH ‘CRASH CUSHIONS’ TO PROTECT WORKERS

DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION
DESTINATIONCAV

CONNECTED VEHICLE CORRIDORS

SMARTPHONE AND IN-VEHICLE TECHNOLOGIES CAN WARN DRIVERS AND AVOID COLLISIONS

DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION

TRAVELER INFO

Minnesota Department of Transportation
January 22 ·

Our snowplows and maintenance vehicles on I-35 are testing technology to boost safety. Once they drive by a digital highway sign, it will warn motorists that a slow-moving vehicle is ahead on the road.

More details: mndot.gov/news/2021/01/22-d6-i35.html

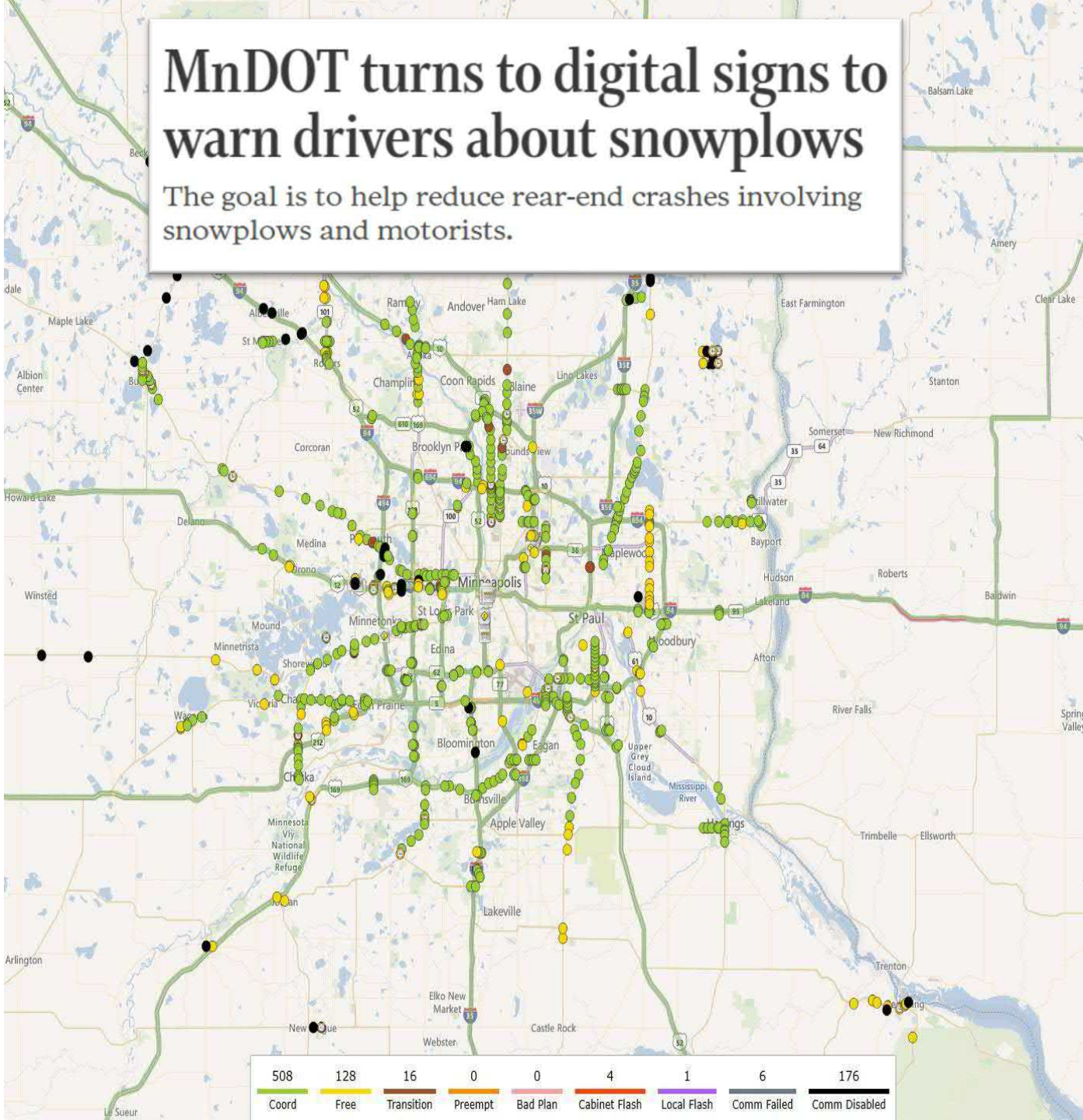
Please note that the sign does not flicker in person. It appears to flicker in the video because of the way the camera captured the LED lights.

12 1 Comment

Like Comment Share

MnDOT turns to digital signs to warn drivers about snowplows

The goal is to help reduce rear-end crashes involving snowplows and motorists.



DESTINATIONCAV

PROJECT BACKGROUND

- Two Level 4 automated shuttles
  - Onboard ambassador
  - Urban route
  - Open to the public
  - 12 months of operation
- Goals
  - Engage
  - Improve
  - Identify
  - Enhance

MED CITY MOVER

DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION

TOP 10* LESSONS LEARNED

1. Begin with the end in mind
2. Equity must be addressed explicitly
3. Prioritize the priorities
4. Workshop ideas
5. Use design thinking and human-centered design
6. Protect IP and trade secrets
7. Technology is a means to an end
8. Create interdisciplinary teams
9. Performance measures and accountability
10. Seek feedback
11. Advertise your program
12. Manage expectations

DESTINATIONCAV

*Disclaimer: I'm a lawyer not a mathematician. I make no warranties for my (in)ability to count.

DEPARTMENT OF TRANSPORTATION

THANK YOU

MINNESOTA CONNECTED AND AUTOMATED VEHICLES PROGRAM

TARA OLDS
Deputy Director
Connected and Automated Vehicles
tara.olds@state.mn.us

DESTINATIONCAV

DEPARTMENT OF TRANSPORTATION

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

AV Pilot Considerations

Scott Shogan, WSP

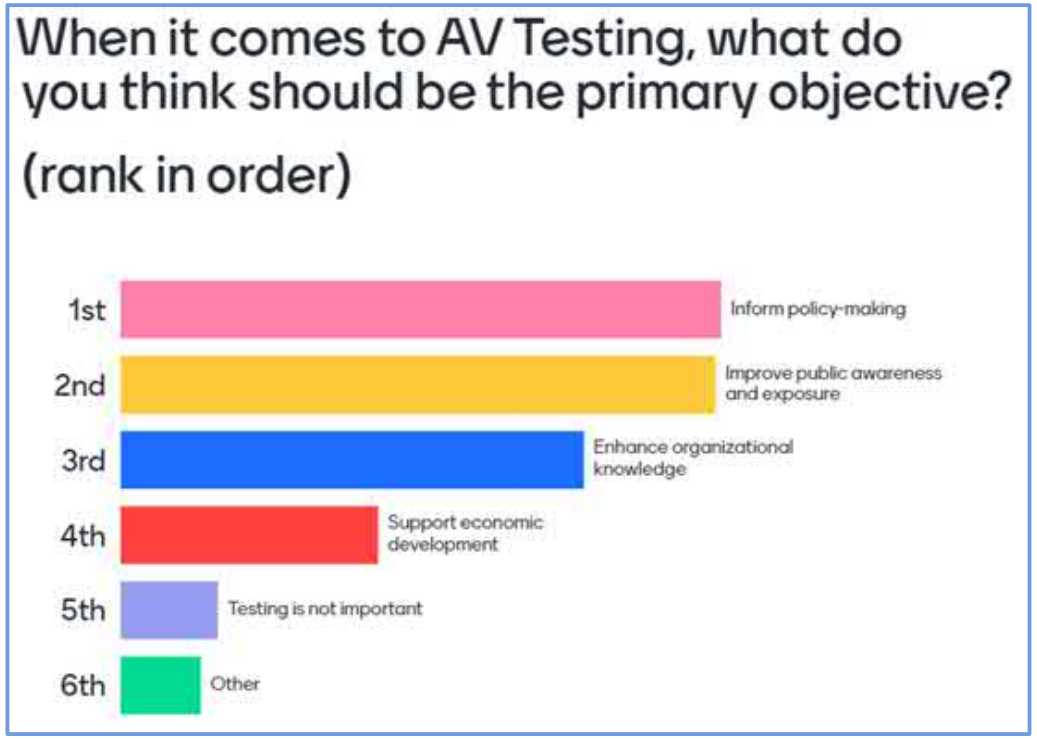
Washington State Transportation Commission

AV Pilot Considerations – Focus on Testing

Executive Committee May 25, 2021 polling exercise

17 of the 22 respondents voting "Yes", indicating a strong interest in bringing AV testing to the state

"informing policy-making" as primary objective of testing in WA, with "improving public awareness and exposure" a close second



AV Pilot Considerations – Pilot Approaches

PILOT APPROACHES

There is a wide range of approaches that vary many aspects of an AV pilot:

- Public vs. Private ownership and control
- Cost and risk sharing
- Level of scope definition
- Procurement mechanism / contracting approach
- How objectives are approached and achieved

AV Pilot Considerations – Pilot Approaches

DEFINED PILOT

Source: UDOT/UTA
http://www.avshuttleutah.com/

- Request for proposals (RFP) for a specific pilot
- RFP defines exactly what is desired of the pilot with a pre-defined approach and specific work scope for the contractor
- A single entity (company or team) is selected and contracted to deliver the pre-defined service

---

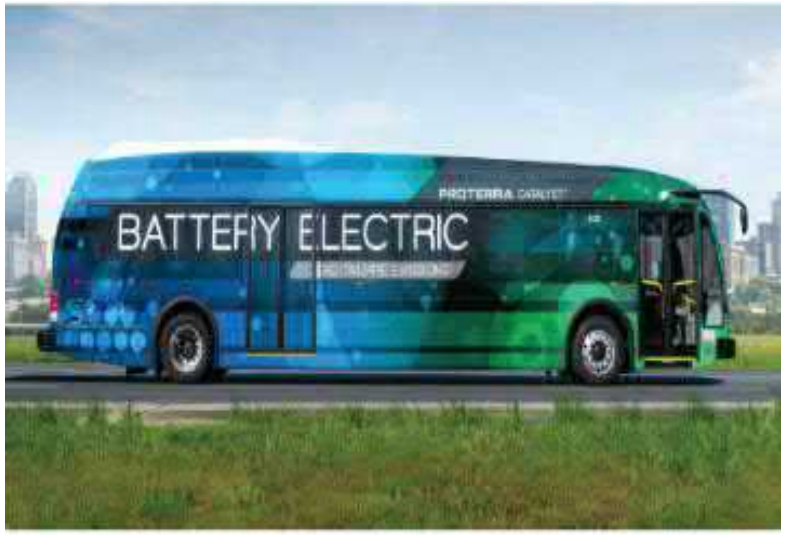
Example: Utah DOT/Utah Transit Authority AV Pilot
http://www.avshuttleutah.com/

PROS:
- Total control over the project scope and design
- More traditional contracting approach for most agencies

CONS:
- Requires the owner to fully define the pilot – less room for industry creativity
- Owner (public sector) will most likely pay the full cost of the pilot, with less potential for private partnership share
- Owner may hold more project risk without “skin in the game” from private partner

AV Pilot Considerations – Pilot Approaches

GRANT PROGRAM



Source: MDOT
http://www.dot.state.mn.us/automated/cavchallenge.html

- Solicitation of interest issued, outlines objectives of pilot program and solicits grant applications for pilot concepts which can meet some or all objectives
- Proposals evaluated on how well they meet objectives, requested amount, etc.
- Multiple grant applications could be accepted (depending on funding requested), or all could be rejected
- Could be a one-time award round or an ongoing program

Example: Minnesota DOT CAV Challenge Program
http://www.dot.state.mn.us/automated/cavchallenge.html

PROS:
- Industry defines how to achieve objectives – more opportunity for creativity and new approaches not considered by owner
- Public-Private Partnership (P3) approach that would more likely yield cost and risk sharing
- Ability to split available funding across multiple worthy pilots

CONS:
- Less control over pilot design and outcomes
- More complex to contract and make selection determinations

AV Pilot Considerations – Pilot Goals

PILOT GOALS

Establishing goals for a potential pilot can guide:

- Type of pilot to pursue
- Pilot approach
- Expectations for both public and private sector
- Align with other related or competing goals (e.g. Environmental, Vision Zero)

AV Pilot Considerations – Vote and Discussion

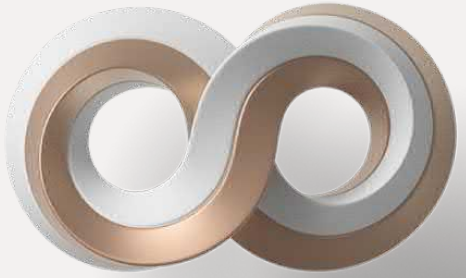
Executive Committee members polling and discussion on potential AV pilot goals and approaches

Michigan Connected and Automated Vehicles (CAV) Corridor

Mark de la Vergne, *Cavnue*

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission



cavnue

The future of roads.

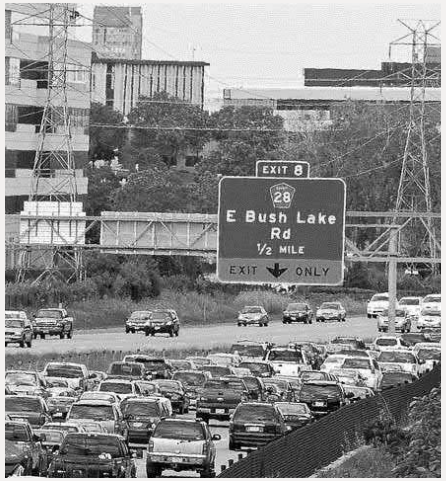
Washington Autonomous Vehicle Work Group
Executive Committee
October 5, 2021

Overseeing infrastructure is an evolving challenge

Safety

While Americans drove less in 2020 an estimated 38,680 people died in motor vehicle traffic crashes—the largest number of fatalities since 2007[1]

Congestion



As US vehicle travel rebounds to near pre-pandemic levels, fifteen states now exceed pre-Covid levels[2]

Freight

Overall freight tonnage will grow to 20.6 billion tons in 2030, up 25.6% from 2019's projection of 16.4 billion tons[3]

Equity

Transportation and mobility play key roles in the struggle for civil rights and equal opportunity in the disability community[4]

Climate

Motor vehicles are the leading cause of air pollution in the United States[5]

[1] - 2020 Fatality Data Show Increased Traffic Fatalities During Pandemic | NHTSA
[2] - As U.S. Vehicle Travel Rebounds To Near Pre-Pandemic Levels, 15 States Have Exceed Pre-COVID Levels; New Report Examines COVID-19 Impact And Current Trends In Vehicle Travell (businessinsider.com)

[3] - Latest Freight Forecast Projects 25.6% Increase in Tonnage by 2030
[4] - Equity in Transportation for People with Disabilities
[5] - Transportation and Climate Change (national geographic)

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 2020	Est. sales volume, K 2023
General Motors *Super Cruise*	2020	22	• Cadillac Lyriq • Buick Encore	37.6	177.3
Ford *BlueCruise*	2020	11	• Mustang Mach-E • F-150 SuperCrew	3.7	52.7
Tesla *Autopilot*	2020	5	• Model X • Model 3	153.5	302
Volvo *Pilot Assist*	2023	2	• Volve XC90 • Volvo XC100	0	7.6
Volkswagen *Traffic Jam Assist*	2020	12	• Volkswagen Atlas • Audi A4	27.4	52.1
Nissan *ProPilot Assist 2.0*	2021	2	• Infiniti QX50 • Infiniti QX55	0	5.5
Toyota *SafetySense 2.5*	2021	46	• Toyota Camry • Lexus LX	0	421.6

Headlines

"GM's Super Cruise Self-Driving Tech Will Be on 22 Vehicles by 2023" — CAR AND DRIVER — Feb 2021

"Tesla Full Self-Driving subscription model coming in Q2 2021" — ROAD & SHOW — Mar 2021

"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	
+Unpredictable environment	

Hundreds of thousands of intractable edge cases

Supportive infrastructure can radically simplify the complexity problem

Simplify

Sense + See

Inform + Coordinate

Permit + Penalize

cavnue

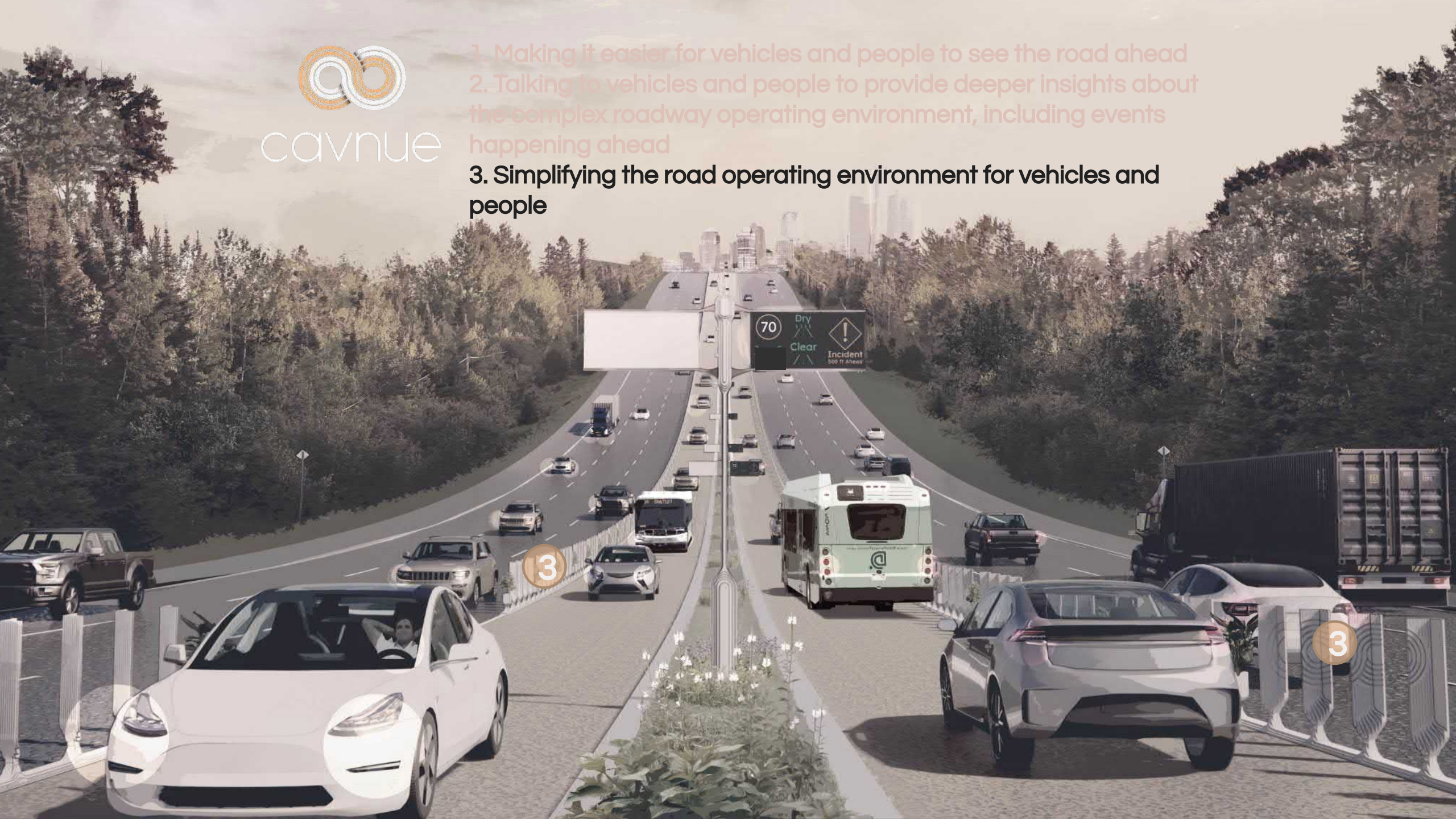
We simplify and enhance the driving environment to address disengagements and enable a hands-off, eyes-off driving experience


cavnue
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
70
Dry
Clear
Incident
1


cavnue
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
2
70
Dry
Clear
Incident

cavnue

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



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

MDOT Michigan Department of Transportation

City of Detroit

Ford

University of Michigan

Detroit Metro • Willow Run
Wayne County Airport Authority

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.

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

AV Work Group Roadmap to the Future Development Update

Scott Shogan, WSP

Washington State Transportation Commission

AV Work Group Future Path - Roadmap

The “Roadmap to the Future” will serve as the Work Group’s Legacy Deliverable and be a foundational resource for law makers.

- Deliver at the end of 2023 (when the Work Group sunsets)
- A plan for the future, how Washington can prepare for AVs
- Framing the Roadmap around tangible use cases potential for testing and deployment in Washington State, put in context

AV Use Cases

Passenger Vehicle ADAS

Truck Platooning

Automated Ride Hailing

Last-Mile Goods Delivery

Automated Transit

AV Use Cases

Passenger Vehicle ADAS

Source: Tesla https://www.tesla.com/autopilot

Advanced driver assist systems (ADAS) offering hands-free freeway driving with automated speed and lateral control, and other advanced automated navigation features

---

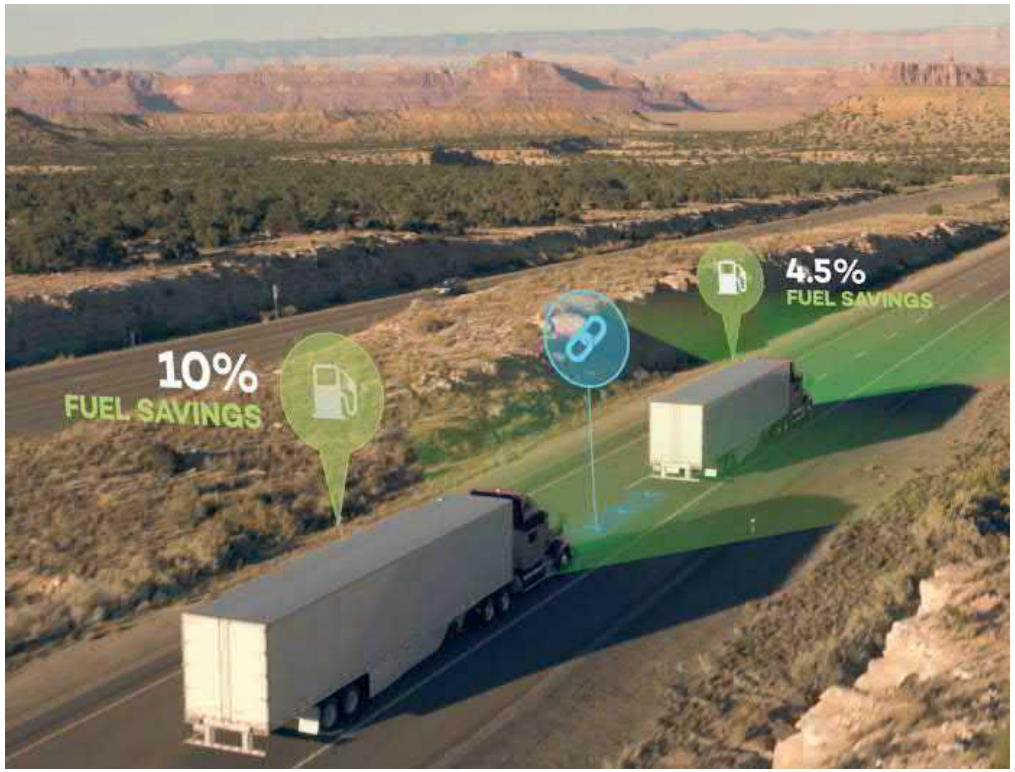
Automation Level / Operating Context: L2 / L3; Urban and rural freeway, limited urban arterial roadway

Current Vehicle / Technology Brand Examples: Tesla Autopilot, GM SuperCruise

Market Readiness: Commercially available

AV Use Cases

Truck Platooning



Automated truck functionality allowing a trailing truck (with or without safety operator) to follow a lead truck at close distance

---

Automation Level / Operating Context: L3 / L4; Rural freeway

Current Vehicle / Technology Brand Examples: Locamation, Peloton

Market Readiness: Current piloting and demonstration

Source: Peloton http://peloton-tech.com/multimedia/#gallery-10

AV Use Cases

Automated Ride Hailing

Automated passenger vehicle (with or without a safety operator) serving as a taxi for a passenger trip within defined geographic limits

---

Automation Level / Operating Context: L4; Urban roadways

Current Vehicle / Technology Brand Examples: Waymo, Amazon Zoox, Cruise

Market Readiness: Current piloting and demonstration

Source: Zoox https://zoox.com/press/

AV Use Cases

Last-Mile Goods Delivery

Vehicles of various form factors providing good delivery to end-customer without a human occupant in the vehicle

---

Automation Level / Operating Context: L4; Urban (generally low-speed) roadways and sidewalks

Current Vehicle / Technology Brand Examples: Nuro, Kiwibot

Market Readiness: Current piloting and demonstration

Source: Nuro https://www.nuro.ai/media-kit

AV Use Cases

Automated Transit

Automated bus functionality, including platooning and precision station platform docking. Operation primarily in dedicated lanes/guideways or bus yards

---

Automation Level / Operating Context: L3/L4; Urban roadways

Current Vehicle / Technology Brand Examples: New Flyer / Robotic Research

Market Readiness: Current piloting and demonstration

Source: Robotic Research https://www.roboticresearch.com/new-flyer-unveils-its-automated-bus-a-cooperation-with-robotic-research/

Vote and Discussion

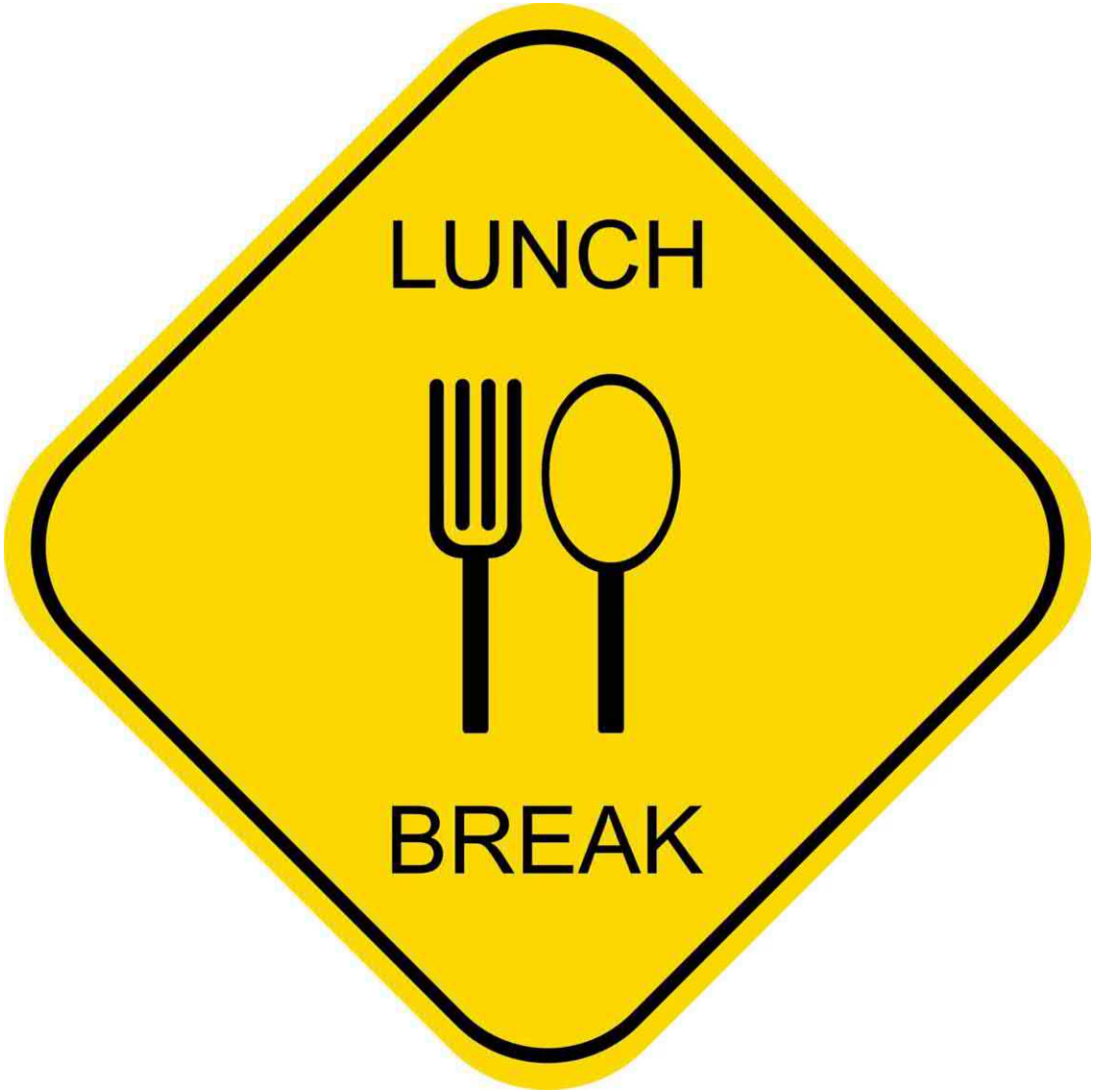
Executive Committee members
polling and discussion on use cases

AV Subcommittee Updates & Recommendations

Subcommittee Chairs

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission



Be back at…

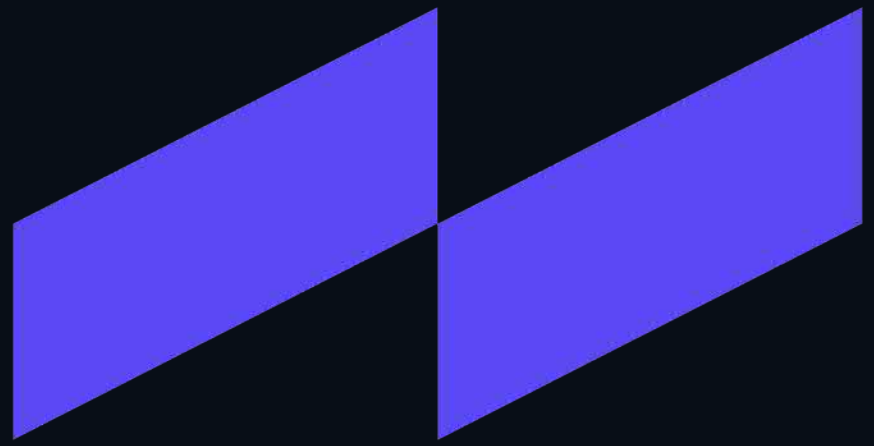
12:00 p.m. PT

AV Industry Panel

Nick Greif, *Motional*
Manuela Papadopol, *Designated Driver*

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission



Motional

Motional

Washington AV Work Group Executive Committee

October 5, 2021

Agenda

Motional Overview
Background & History

Operating a Commercial Robotaxi Fleet
Las Vegas Rideshare

Industry Collaboration & Safety
nuScenes & nuPlan

Q&A

Motional Overview

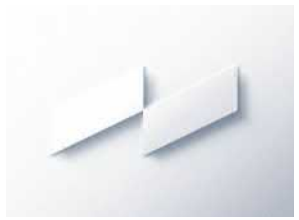
MEET MOTIONAL.

We're making driverless vehicles a safe, reliable and accesible reality.

We're new in name only. We've been revolutionizing the field for decades, from the founding of our technology at MIT and Carnegie Mellon, to the creation of Motional - born out of investment from Hyundai Motor Group and Aptiv.

We're creating, shaping, and advancing technology capable of saving lives, time, and money.

We're Motional, and we're changing how the world moves.



Motional Technical Heritage

2013
+ Ottomatika founded out of CMU
+ nuTonomy founded out of MIT
+ Team members placed 1st, 4th in 2007 DUC

2014
+ nuTonomy tests fully autonomous taxi service in Singapore

2015
+ Aptiv acquires Ottomatika
+ First U.S. cross country drive (3,400 miles) by Ottomatika and Aptiv

2016
+ nuTonomy launches world's first public AV demo in Singapore w/ Grab

2017
+ nuTonomy launches AVs on Boston roads
+ Aptiv acquires nuTonomy

2018
+ First commercial AV deployment w/ Lyft
+ Grand opening of Las Vegas Tech Center

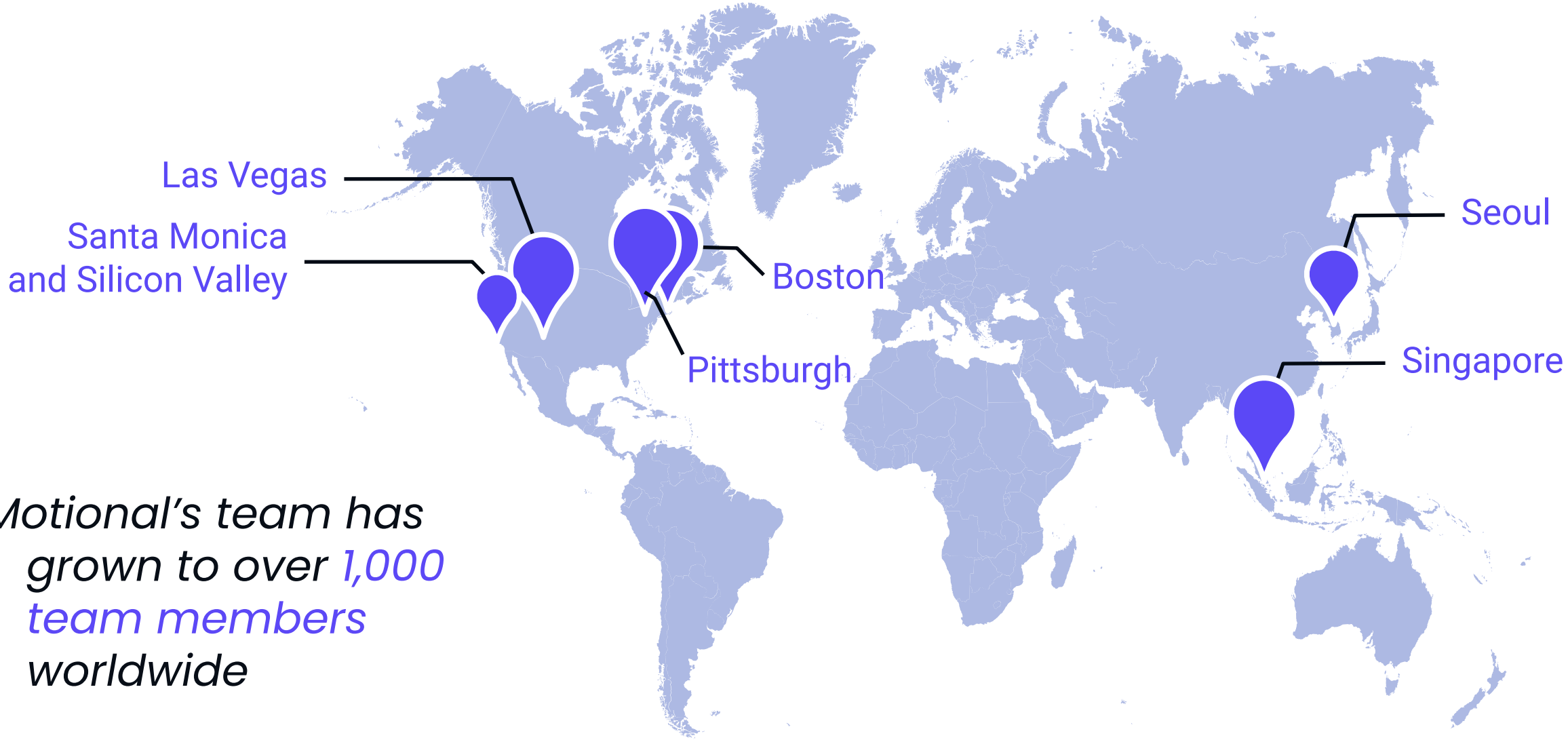
2019
+ nuScenes by Aptiv dataset releases
+ Aptiv publishes *Safety First for Automated Driving* white paper
+ 70k commercial rides with Lyft

2020
+ Aptiv + Hyundai form Motional
+ 100K+ commercial rides
+ Via Partnership
+ Lyft announcement of future commercialization in multiple US cities

2021
+ Motional becomes one of the first in the world to operate without a driver on public roads
+ Motional expands U.S. operations in California and Las Vegas
+ Motional reveals next-generation robotaxi; all-electric Hyundai IONIQ 5

2022+
+ Continue commercialization
+ Evaluate future markets and expansion opportunities

Motional Footprint



Motional's team has grown to over 1,000 team members worldwide

Why Driverless Technology

Safer Roads

Vast majority of automotive accidents are caused by **human error**. Driverless vehicles are never drunk, drowsy, or distracted – and have the potential to save *millions* of lives.

More Sustainable Transportation

Driverless technology provides **efficient** and **electric**, transportation and can **reduce dependency on private car ownership**, leading to lower pollution.

Increased Quality of Life

The average American spends **over a year of their life commuting** – time that can be better spent working, relaxing, or socializing. **Fewer cars will lead to better utilization of roads and public spaces.**

Better Access to Transportation

At Motional, we believe driverless vehicles can provide more **affordable, accessible, and equitable** access to transportation. We're building our technology to serve everyone.

Introducing Motional's Next-Generation Robotaxi: The all-electric Hyundai IONIQ 5

In March, Motional announced the Hyundai IONIQ 5 will be the vehicle for its next-generation robotaxi:

- This marks Motional's fifth vehicle platform and our **first all-electric commercial robotaxi**
- The IONIQ 5 is built on Hyundai's dedicated **battery electric vehicle (BEV) platform**
- Vehicle used in Motional's fully-driverless **robotaxi service** launching in 2023
- It will **introduce thousands of consumers to driverless technology**

Our Path to Deployment - Test, Test, Test

Before launching a new service area, we have a multi-year process that ensures a successful and safe deployment.

Constant refinement of our passenger experience to deliver an exceptional and seamless end-to-end ride

Operating a Commercial Robotaxi Fleet

First Commercial Robotaxi Fleet Offered on a Major Ride Hailing Network

100k+ Paid AV Rides

9/10 Would Ride Again

98% ★★★★★ **Star User Rating**

Operating the world's longest-standing public self-driving ride-hailing service has taught us what it takes to deliver **safe** and **reliable** autonomous mobility at scale.

Operating a Large Fleet

Motional operates a fleet of overall 100 vehicles at its Las Vegas Technical Center. Managing a large fleet has helped educate the company on how to deliver robotaxi services, not just design a safe robotaxi.

- Valuable experience in workforce training and management, vehicle cleaning and servicing, and fleet hours of service and area distribution.
  - Motional vehicles achieve more rides per hour than a typical rideshare vehicle.
- Significant requirements for depots, such as location centrality and energy grid capabilities.

Operating an efficient robotaxi fleet is critical to enable **low costs for the consumer** and **high numbers of rides per hour** for the vehicle.

Rider Feedback

Riders partaking in the Motional-Lyft AV network in Las Vegas can provide both a star rating and written feedback on the experience.

- Positive overall experience.
- Most feedback focuses on the end-to-end customer experience (i.e. trunk space, roomy backseat, vehicle occupancy capacity, etc.).
  - Less feedback on the technology itself.
- Autonomous rides quickly become routine after the initial excitement of self-driving.

This rider feedback reaffirms our view that operating an autonomous service isn't just about driverless technology and getting safely from Point A to Point B, but the **full end-to-end customer experience**.

Las Vegas Partners & Pick-Up Drop-Off Zones

Operating a robotaxi service at scale can't occur without strong, cooperative relationships with local officials – and learning together.

- Collaborative efforts with the State of Nevada and Las Vegas' Innovation District.
- Partnerships with hotel properties where most ride pick ups and drop off requests are located, but are located on private property.
- Engaged with local businesses to identify 3,600 popular pick-up drop-off locations.

While the ride is seamless for passengers, it takes **lots of behind-the-scenes effort** and preparation to make the experience a reality.

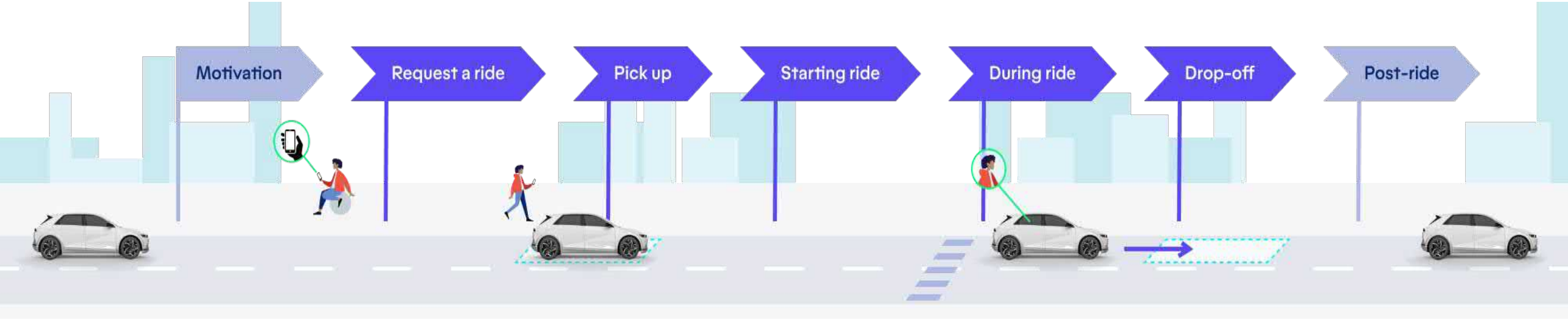
Ensuring a Smooth Ride

A person's perception of ride quality is fundamentally different when they're driving versus when they're a passenger in a human driven vehicle. Motional is designing for an entirely new experience for passengers.

- To make a driverless vehicle that works for everyone, we have to build a product that exceeds rider expectations.
- Significant user research and data collection
  - Demand data (where do people want to go)
  - User experience surveys
  - Disability group collaborations

We apply research and data to develop an understanding of those using our driverless services, **what factors matter to them when it comes to AV behavior**, and ensuring the product we're offering is accessible to everyone.

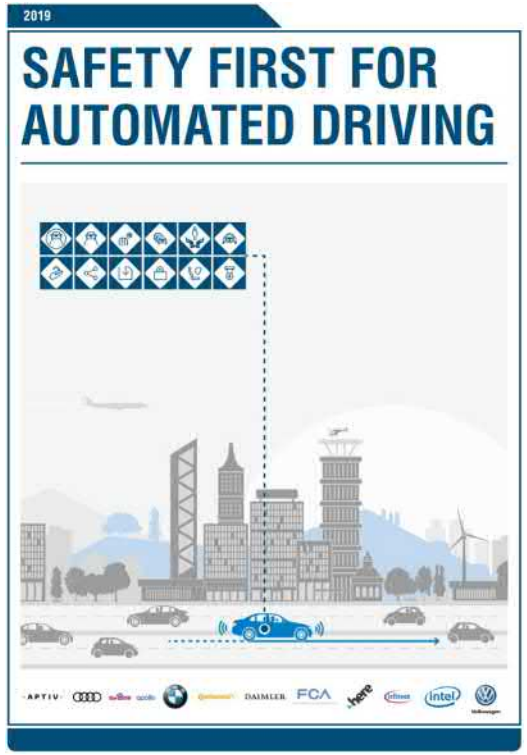
The Robotaxi Passenger Journey



Motivation	Request a ride	Pick up	Starting ride	During ride	Drop-off	Post-ride
Passenger requests a ride using booking app	Passenger IDs car using standard info as well as feedback from the car (lights, sound) Passenger unlocks the car and opens the doors from app	The car ensures passenger is ready through automated safety checks Passenger starts ride through app or the display		Passenger changes the temp, lighting, and audio through app or the display If needed, passenger contacts Remote Customer Assistance		Passenger opens trunk using app or display If passenger forgets luggage, the car auto detects lost items

Industry Collaboration & Safety

Safety is the Driver: Supporting Safety Across the Industry



- We published our approach to validation as part of a consortium in **Safety First for Automated Driving**, adopted as an ISO technical report.
- Our holistic approach to safety is shared in detail in Motional's **Voluntary Safety Self Assessment**; Our approach has resulted in extensive operations with **0 at-fault accidents.**
- We are unique in our industry in our decision to engage with **TUV SUD** for an independent 18 month-long safety audit.
- Our safety engineering culminated in our announcement that we became one of the first companies in the world to put **driverless cars on public roads**.

nuScenes - Aiding AV Perception Research

Motional began out of academic research and that commitment to research, open data, and a philosophy of sharing continues.

- In 2019 Motional published the annotated nuScenes data set containing 1.4M high quality images and 400K lidar sweeps.
- Datasets are critical in machine learning models.
- nuScenes was the largest and most detailed data set publicly available at the time and has since been updates with Lidar segmentation and additional set of images.
- This dataset has been referenced in 600 academic papers and encouraged data sharing from other industry players.

Motional supports **public research into computer vision and autonomous driving** as part of its goal to make driverless vehicles a safe, reliable, and accessible reality.

nuPlan - Aiding AV Planning Research

While perception endows an autonomous vehicle with the ability to see the world, planning helps the vehicle more safely navigate it. Where nuScenes helped researchers with AV perception, nuPlan will help AV researchers select the best route to safely navigate the world AVs perceive.

- Large-scale machine learning dataset and a toolkit for measuring the performance of planning techniques – essentially a virtual driving test.
- 500 million images and 100 million lidar scans.

With the introduction of nuPlan, we hope that by providing a large-scale dataset and common benchmark, we will now pave a path towards progress in **planning**, which is perhaps **one of the final frontiers in autonomous driving**.

Thank You!

DEBUNKING MYTHS ABOUT TELEOPERATIONS

Manuela Papadopol, CEO

Designateddriver.ai

October 2021

MYTH 1

TELEOPS IS REMOTE DRIVING.

designated driver

FACT

TELEOPS MEANS MONITOR, ASSIST, DRIVE.

designated driver

MYTH 2

AV SYSTEMS DO NOT NEED TELEOPS.

designated driver

FACT

TELEOPS IS THE SAFETY NET OF AV.

designated driver

MYTH 3

LOW LATENCY IS CRITICAL FOR TELEOPS.

designated driver

FACT

LOW LATENCY IS CRITICAL FOR REMOTE DRIVING.

designated driver

MYTH 4

5G IS A MUST FOR TELEOPS.

designated driver

FACT

5G UNLEASHES NEW OPPORTUNITIES.

designated driver

MYTH 5

TELEOPS IS JUST FOR ROBO TAXIS AND SHUTTLES.

designated driver

FACT

TELEOPS BRINGS VALUE TO ANY VEHICLE AND ANY SITUATION.

designated driver

MYTH 6

IF YOU MASTER RACING VIDEO GAMES YOU CAN BE A TELEOPERATOR.

designated driver

FACT

TELEOPERATORS ARE NOT GAMERS HAVING FUN.

designated driver

DEBUNKING MYTHS ABOUT TELEOPERATIONS

Manuela Papadopol, CEO

Designateddriver.ai

October 2021

Executive Committee Member Items

Open Forum

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission

NHTSA National AV Update

Acting Administrator Dr. Steven Cliff,
NHTSA

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State
Transportation Commission

GHSA Report: Law Enforcement, First Responder, and Crash Investigation Preparation for Automated Vehicle Technology

Tammy Trimble, Virginia Tech Transportation Institute

WASHINGTON STATE AUTONOMOUS VEHICLE WORK GROUP

Washington State Transportation Commission

VIRGINIA TECH TRANSPORTATION INSTITUTE
VIRGINIA TECH

Advancing Transportation through Innovation

GHSA Report: Law Enforcement, First Responder, and Crash Investigation Preparation for Automated Vehicle Technologies

TAMMY TRIMBLE, PH.D.

DIVISION OF DATA AND ANALYTICS

VIRGINIA TECH TRANSPORTATION INSTITUTE
VIRGINIA TECH

Advancing Transportation through Innovation

OVERVIEW

- Project objectives and approach
- Curriculum development considerations
- Potential curriculum recommendations
- Barriers and opportunities moving forward

Project Objectives

- Distill and summarize strategies for integrating Automated Driving System (ADS)-equipped vehicles into the U.S. fleet without significant disruption to the protocols of public safety
- Develop proposed curricula that would provide a knowledge base surrounding Advanced Driver Assistance Systems (ADAS) and ADS deployment for law enforcement officials, first responders, and crash investigators

Public Safety Providers Defined

- Includes law enforcement, first responders, crash investigators
- Includes administrative personnel as well as rank and file officers

Approach

1. Literature review
2. Discussions with government administrators, first responder and law enforcement organizations, automakers, crash reconstruction organizations, and insurance and safety advocates
3. Synthesized findings from the literature review and discussions to develop the curriculum recommendations

CURRICULUM DEVELOPMENT CONSIDERATIONS

- WHY IS TRAINING NEEDED?
- WHERE SHOULD TRAINING BE PROVIDED?
- WHEN SHOULD TRAINING BE PROVIDED?
- WHO SHOULD PROVIDE TRAINING-RELATED INFORMATION?
- HOW SHOULD TRAINING BE PROVIDED?
- WHAT TRAINING SHOULD BE PROVIDED?

Why Is Training Needed?

- Current understanding of ADAS and ADS technologies is limited
- Questions persist
  - How will we disable an ADS-equipped vehicle, investigate an abandoned vehicle or perform stabilization or extrication?
  - How do we know the ADS-equipped vehicle has sensed or detected the presence of an emergency vehicle that is responding to an incident or the presence of a first responder who is conducting traffic direction and control?
  - How do we determine ownership of an ADS-equipped vehicle? How is responsibility assigned at an incident or when conducting a traffic stop?
- Training, combined with first responder interaction plans, will allow public safety personnel to focus on the other job demands

Where Should Training Be Provided?

- Common training opportunities
  - Academy or roll-call trainings
  - Traffic Incident Management Systems (TIMS) training
  - Annual crash investigation training
  - Conferences
  - Other annual trainings
  - Online trainings

When Should Training Be Provided?

- Basic training in the near term
- More advanced training as technologies become more prevalent

Who Should Provide Training?

- Accreditation organizations
- Membership organizations
- State and local precincts and departments
- Standards organizations
- Federal government initiatives
- Academic institutions

How Should Training Be Provided?

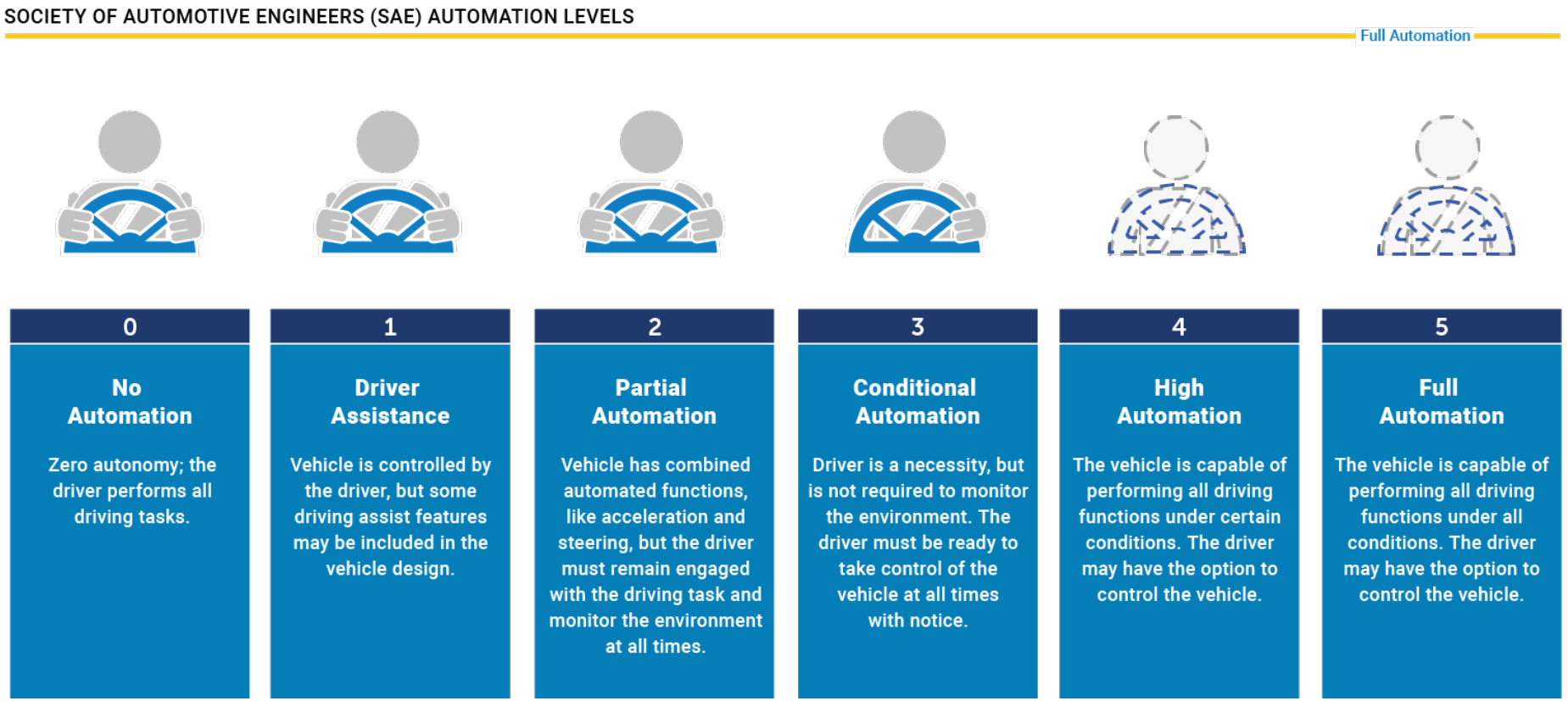
- Format
  - Easy to comprehend
  - Engaging
  - Relevant
  - Continuously updated
- Approach
  - Modular approach
  - Blended training
  - Experiential training

What Training Should Be Provided?

- Identified six curriculum topics, ranging from basic to more advanced
  - Help to reduce uncertainty and misconceptions regarding the technologies and identify how providers may interact with them in the field
- Presented with the understanding that ADAS and ADS technologies are continuously evolving
  - Training materials must be agile to accommodate future changes

1. Understanding the Differences between ADAS- and ADS-equipped Vehicles

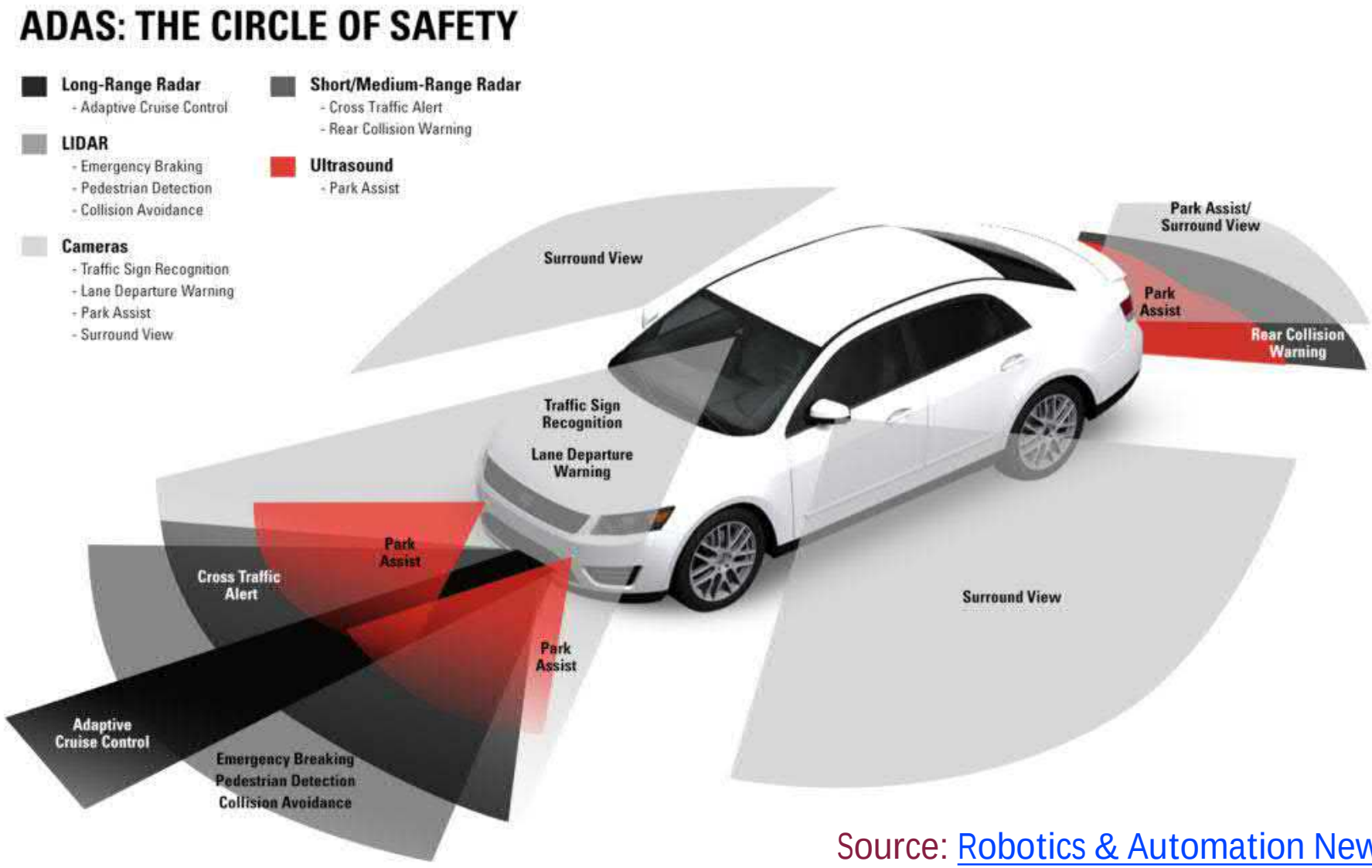
- Provide a common understanding of ADAS and ADS technologies at a foundational level



SAE Automation Levels as described by the National Highway Traffic Safety Administration

2. Identifying ADAS Technologies on the Road Today

- Explore ADAS technologies in greater detail



Source: [Robotics & Automation News]

3. Understanding Governmental Responsibilities Regarding Vehicle Oversight

- Provide individuals the ability to list and describe federal and state responsibilities regarding ADAS- and ADS-equipped vehicles

Source: National Conference of State Legislatures

4. Anticipating ADAS- and ADS-equipped Vehicle Deployment

- Provide individuals with the ability to explain the features and associated capabilities included on departmental vehicles
- Identify any potential ADS-equipped vehicle deployments in their region

Source: AV TEST Initiative

5. Interacting with ADS-equipped Vehicles

- Provide an overview of the types of interactions that first responders may have with ADS-equipped civilian vehicles and unique deployments

Responding to an Incident	Securing the Scene	Traffic Direction and Control	Traffic Stops and Checkpoints	Abandoned or Unattended Vehicles	Stabilization and Extrication
					
Domains: Law Enforcement Fire and Rescue EMS	**Domains:** Law Enforcement Fire and Rescue EMS	**Domains:** Law Enforcement Fire and Rescue EMS	**Domain:** Law Enforcement	**Domain:** Law Enforcement	**Domain:** Fire and Rescue

Sources: Terry et al., 2018; AVSC, 2020

6. Understanding and Accessing Data

- Provide an overview of the data available and how to access

Subfield 2	Automation System Levels in Vehicle	Select 1-5
00	No Automation	
01	Driver Assistance	
02	Partial Automation	
03	Conditional Automation	
04	High Automation	
05	Full Automation	
06	Automation Level Unknown	
99	Unknown	

Source: MMUCC Excerpt – DMV1. Motor Vehicle Automated Driving System(s) Subfield 3

VIRGINIA TECH TRANSPORTATION INSTITUTE
VIRGINIA TECH

Advancing Transportation through Innovation

MOVING FORWARD

BARRIERS TO EFFECTIVE TRAINING OPPORTUNITIES

Barriers to Effective Training

- Competing training demands
- Outdated training
- Non-engaging training
- Budgetary constraints

Opportunities Moving Forward

- Identification of departmental champions
- Public private partnerships

VIRGINIA TECH TRANSPORTATION INSTITUTE
VIRGINIA TECH

Advancing Transportation through Innovation

Thank you!

Tammy Trimble, Ph.D.

Sr. Research Associate

Division of Data and Analytics

ttrimble@vtti.vt.edu

Closing Remarks

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State
Transportation Commission

Closing Remarks

- **Recap Today's Meeting:**
  - » Action Items
  - » Agreements / Decisions

- **Important Dates:**
  - » October 19-20, 2021 – Transportation Commission meeting (*Annual Report preview Oct 20)*
  - » November 15, 2021 – 2021 Annual Report due to the Governor & Legislature

Thank You!

WASHINGTON STATE
AUTONOMOUS VEHICLE
WORK GROUP

Washington State
Transportation Commission