



Getting to Zero with CAV

Washington County **SRF**
m DEPARTMENT OF TRANSPORTATION

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What is CAV?

A C E S



Automated

Connected

Electric

Shared

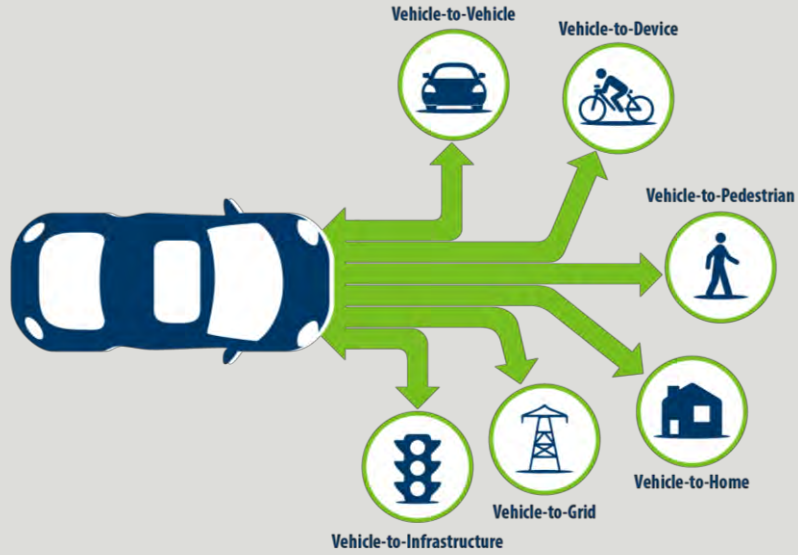
What does it look like?



How does it work?



How does it communicate?









5

Why are we talking about CAV?









What will it impact?

<p>Greater Mobility & Equity</p> 	<p>Workforce</p> 	<p>Traffic Operations</p> 
<p>Economic Development</p> 	<p>Infrastructure</p> 	<p>Health & Environment</p> 

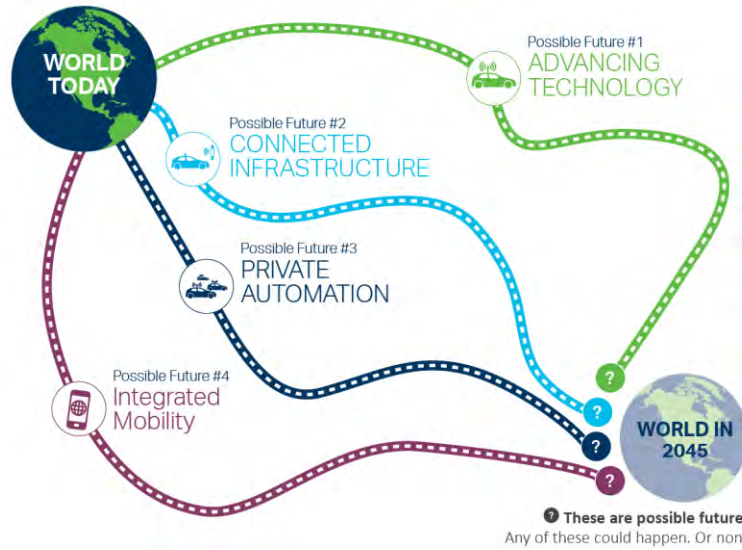
How do we talk about it?

← No Automation | Full Automation →

					
0	1	2	3	4	5
No Automation	Driver Assist	Partial Automation	Conditional Automation	High Automation	Full Automation
Model T Honda Fit	Ford Jeep Compass	Tesla Model 3	Audi A8	EasyMile Shuttle	?

Highly Automated Vehicles

When is it coming?



How do we plan for it?



1

Leadership

Who is leading these efforts?

Advisory Council

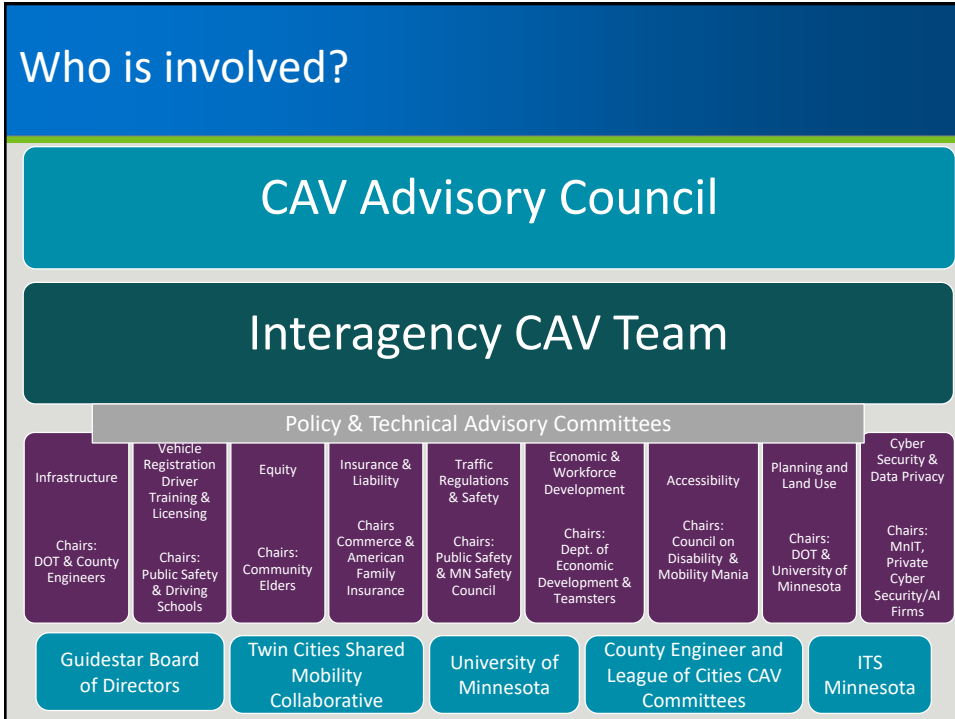
- Public-private partnership
- Vision and goals

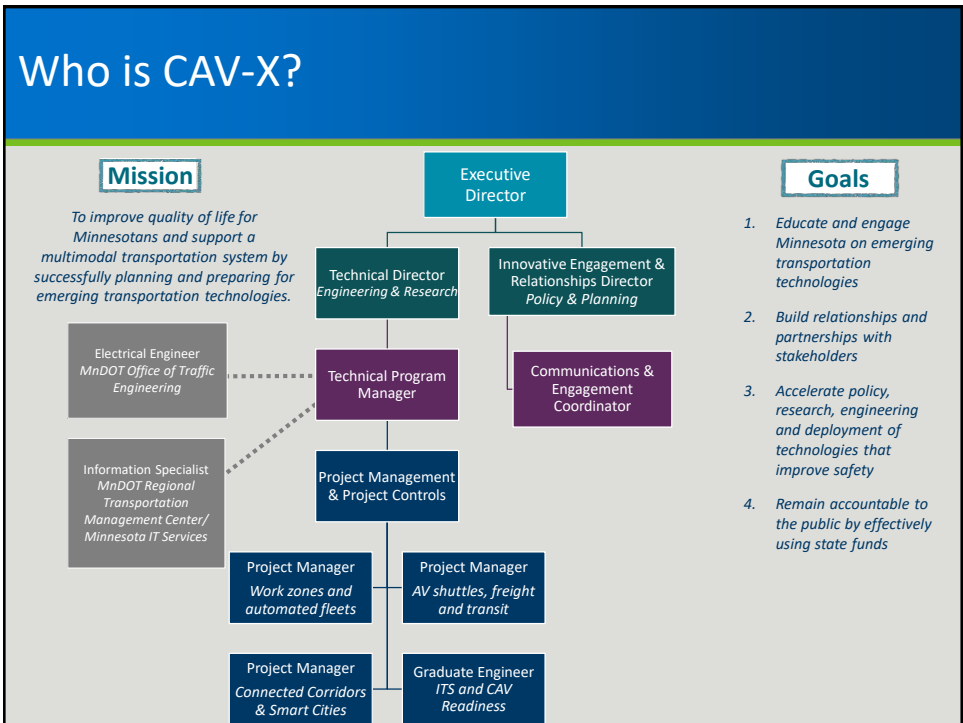
Interagency CAV Team

- Statewide collaboration
- Coordinate programs

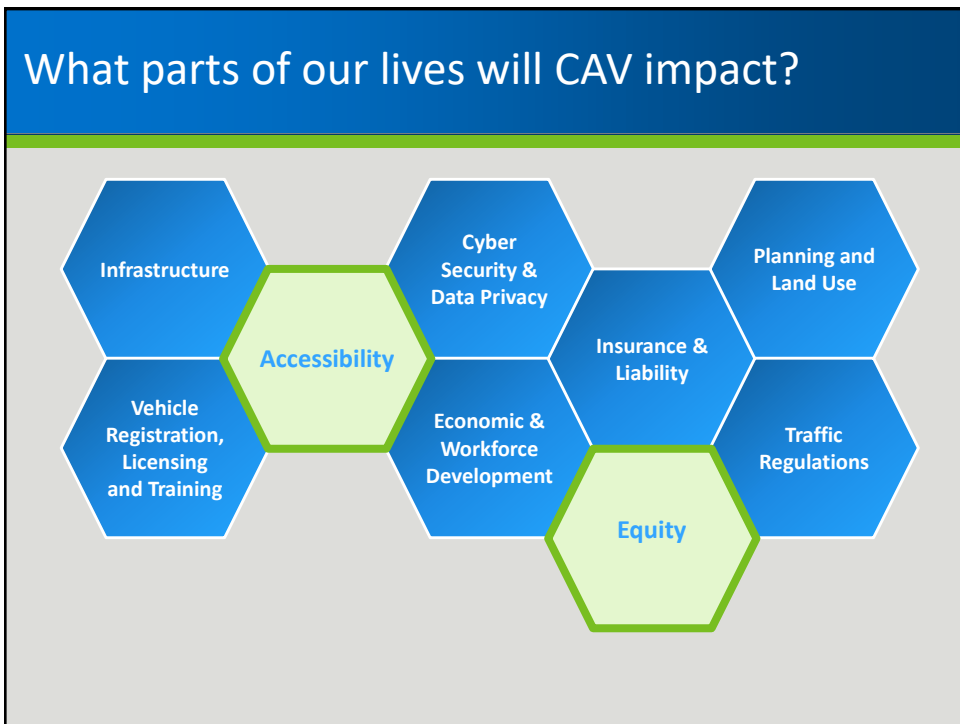
Policy Subcommittees

- Technical and policy expertise
- Develop policy and programs
- Public and private involvement





20 Law & Policy



What does the Advisory Council recommend?



“Authorize testing without human drivers”

“Invest in fiber, signals, pavement markings and smart signs”

“Prioritize safety for all users: pedestrians, cyclists, people with disabilities, transit, and others”

“Conduct pilot projects in urban, suburban, rural areas to public can see the tech and guide policy”

“Create a public engagement plan”

Is it legal?

02/20/19 REVISOR KR/RC 19-0261 as introduced

SENATE
STATE OF MINNESOTA
NINETY-FIRST SESSION
S.F. No. 2173

1.1 A bill for a
1.2 relating to motor vehicles; regulating autom
1.3 penalty; requiring a report; amending Minn
1.4
1.5
1.6
1.7
1.8
1.9 Subd. 3b. Automated driving system. “A
1.10 that allows a vehicle to be tested without any
1.11
1.12
1.13 Subd. 29a. Federal motor vehicle safety standards automated vehicle
1.14 exemption. “Federal motor vehicle safety standards automated vehicle exemption” means
1.15 an exemption from the United States secretary of transportation from the motor vehicle
1.16 safety standards under the National Traffic and Motor Vehicle Safety Act.
1.17
1.18
1.19 Subd. 34a. Highly automated vehicle. “Highly automated vehicle” means a motor
1.20 vehicle equipped with automated technology with the capability to function without a human
1.21 operator present in the vehicle. A highly automated vehicle does not include a vehicle

A state task force wants self-driving cars on the road in Minnesota. Legislators aren't so sure



What is allowed in Minnesota?

Automated 'platoons' of trucks might soon be driving on Minnesota roads

02/26/19
This document can be made readable in alternative formats upon request.

State of Minnesota
HOUSE OF REPRESENTATIVES
SIXTY-FIRST SESSION
H. F. No. 1995

Adopted by House, Yelich, Korman and Sibley
The bill was read for the first time and referred to the Transportation Finance and Policy Division

1.1 A bill for an act
1.2 relating to transportation; authorizing vehicle platooning systems; amending
1.3 Minnesota Statutes 2018, sections 169.011, by adding subdivisions; 169.18,
1.4 subdivision 9; proposing coding for new law in Minnesota Statutes, chapter 169;
1.5 BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF MINNESOTA:

1.6 Section 1. Minnesota Statutes 2018, section 169.011, is amended by adding a subdivision
1.7 to read:

1.8 "Subd. 5D. **Platooning system.** "Platooning system" means driver-assisted
1.9 vehicle-to-vehicle technology that integrates electronic communications between and among
1.10 multiple vehicles to synchronize speed, acceleration, and braking while leaving system
1.11 monitoring and intervention in the control of each vehicle's human operator.

1.12 Sec. 2. Minnesota Statutes 2018, section 169.011, is amended by adding a subdivision to
1.13 read:

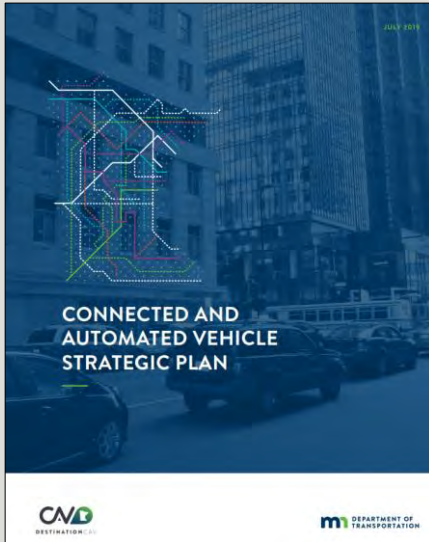
1.14 "Subd. 92a. **Vehicle platoon.** "Vehicle platoon" means a group of commercial vehicles
1.15 traveling in a unified manner through use of a platooning system or systems. A vehicle
1.16 platoon consists of a lead vehicle and following vehicles. Notwithstanding section 169.01,
1.17 a vehicle platoon may consist of up to three vehicles. A vehicle platoon is not a combination
1.18 vehicle under this chapter.



3

Planning

How is MnDOT planning for CAV?



Capital Investment

Research

Partnerships

Law and policy

Operations & Maintenance

Multimodal

Strategic Staffing

Communications

Long-Range Planning

How do you plan for an unknown future?

Strategic Investment



1

Innovation



2

Collaboration & Knowledge-Sharing



3

4

CAV Projects & The Four Es

Infrastructure – Fiber, Markings, Signals & Signs



Research – Platooning, Freight, Snow, Detection



Partnerships – Minnesota CAV Challenge

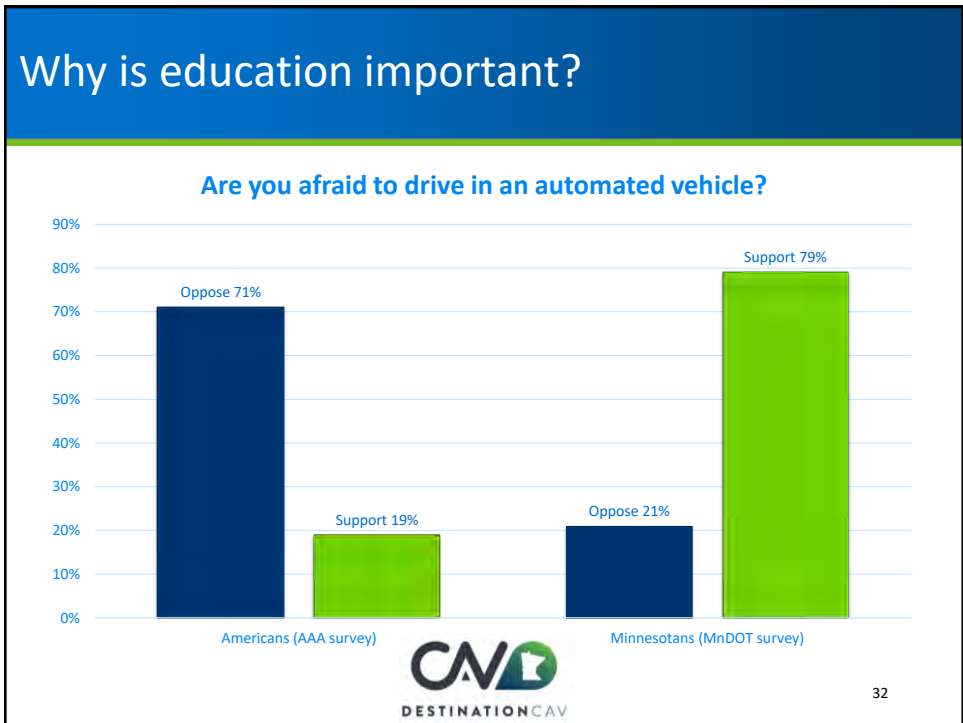


Operations & Maintenance – Data, Work Zones & Crash Cushions



Multimodal – Transit, Freight, Platooning, Bikes and Pedestrians





50 CAV & Local Projects



CAV Local Impacts

mi DEPARTMENT OF TRANSPORTATION

Wayne Sandberg, PE | Washington County Engineer

Minnesota Highway System

Roadway Type	Miles
Interstate	914
Trunk Highway	10,813
County Highways	43,530
City	22,487
Other	60,705
State Total	138,449

County Highway System

- 4x Larger than State System
- Variable Configurations
 - Two Lane Rural Roads
 - Multi Lane Suburban Arterials
 - Urban Core – Multi Modal
 - Surface Type
 - Traffic Volumes
 - Truck Routes

Local Road Research Board



Preparing Local Agencies for the Future of Connected and Autonomous Vehicles

Shauna Hallmark, Principal Investigator
Institute for Transportation
Iowa State University

MAY 2019

Research Project
Final Report 2019-18



Report 2019-18

- Principal Investigator: Shauna Hallmark
- Technical Liaison: Douglas Fischer
- Project Coordinator: Thomas Johnson-Kaiser



Minnesota Toward Zero Deaths Conference
October 23-24, 2019 St. Cloud, MN, USA

Toolbox for Local Agencies

- Prepare for CAV
- 5-10 year window
- Acknowledge rapidly changing environment
- **Recommend caution on investment**

Transition

- Will take time
- 270 million registered personally owned vehicles on road today
- Deployment will be gradual – especially on local system
 - Start with automated driver assist
 - Continue with gradually increasing assistance
- Dual existence for many years

Pavement Markings

- Top consideration for local agencies right now
- Presence – are the lanes marked?
- Conspicuity – can the lines be seen?
- Clarity – what message is being sent?

Pavement Markings



Shutterstock

Figure 3-2. Example of overlapping pavement markings

Signs

- CAV uses cameras – sign recognition
- Visibility – are the signs visible?
- Minimize Signs – do you have too many signs? Signs not needed?
- Standardization – use standard signs whenever possible
- Clear messages – remove conflicting signs

Signs



FHWA (left) and Shutterstock (two images on the right)

Figure 3-6. Examples of problematic signage with sign blocked (left) and damaged signs (right)

Maintenance

- Consider current and future maintenance expectations and levels
- Acceptable road hazards?
- Erratic driver behavior?

Maintenance



Shutterstock
Figure 3-9. Examples of road surface degradation

Summary

- What you can do now for CAV is basic stuff
- Good for CAV and for existing drivers
 - Especially older drivers
 - People unfamiliar with area
- Good investments to make NOW

What is next?

- County Engineers – CAV Committee
- City Engineers – CAV Committee
- Communication
- Data Capture and Information Sharing and Inventory
- Consistency and Standardization
 - National Committee on Uniform Traffic Control Devices (NCUTCD) Guidance
 - Minnesota Committee on Uniform Traffic Control Devices (MCUTCD)

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Consultants
and CAV

Interaction of Public/Private/Academic

- Minnesota Guidestar
 - Founded in 1990s
 - MnDOT and MPS perspectives
 - Legislative outreach



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TRANSPORTATION **T3** forum TECHNOLOGY & TRENDS

- Follow CAV and other emerging technologies
- Focus on impact to local agencies
- Hosted by SRF and Minnesota Guidestar
- Webinar format; 8-9am quarterly
- Next date Dec 4 (tentative)
- Open to all!!



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Consultant Role #1 – Expertise

- Technology deep dive
 - Non-intrusive traffic detection
 - 1994 to now
 - Compared 20+ different sensors
 - Next generation of detection



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Consultant Role #2 – Knowledge

- Breadth of experience
- Variety of clients/needs
- ITS On-Call in 6 states
- City, County, State, Federal
- MDOT tool to forecast CAV benefits



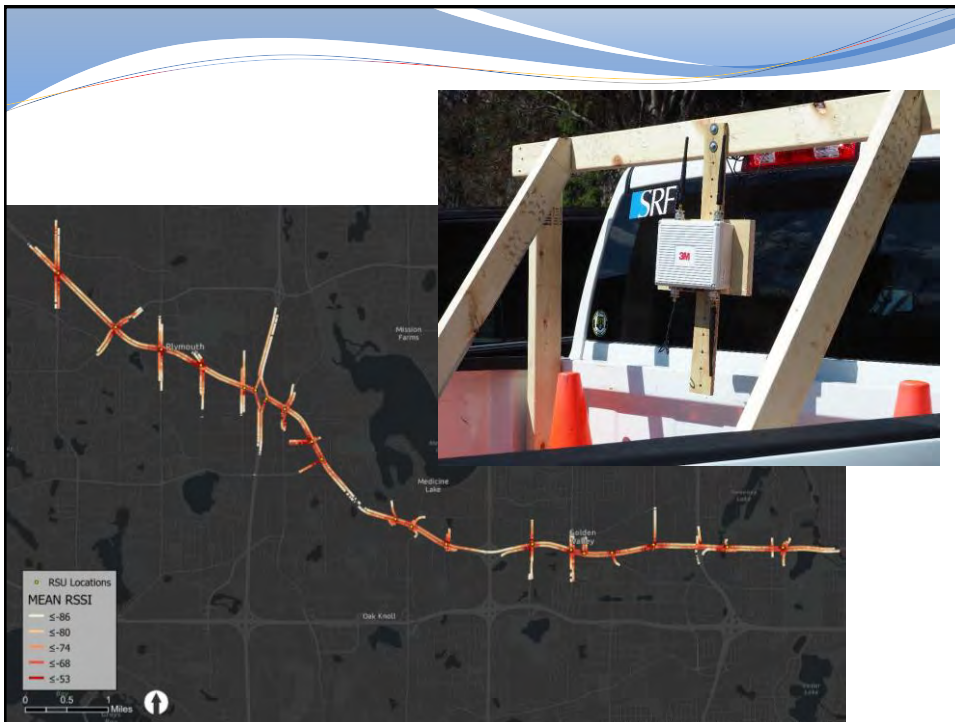
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Consultant Role #3 – MacGyver

- TH 55 CAV deployment (Connected Corridor Project)
 - Signal Phase and Timing (SPaT) Challenge
 - Enables:
 - Red light violation warning
 - Eco-Driving
- Bleeding edge



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Consultant Takeaway – Long View

- Follow trends
- Stay knowledgeable



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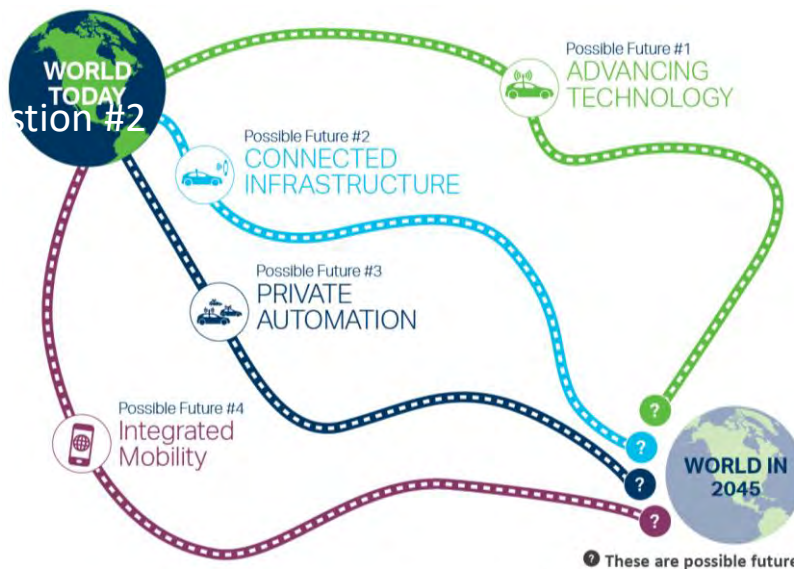
Top 10
Questions
for CAV

Question 1: How can we make sure CAVs are safe?

- Understand federal and state roles
- Monitor evolution of technology
- Collaboration between government and auto industry
- Share data and information



Question 2: When will autonomous vehicles arrive?



Question 3: Why is it taking so long?

- Technology/Cost
- Safety
- Fleet turnover
- Policy

Waymo tells riders that 'completely driverless' vehicles are on the way

"You can enjoy having the car to yourself"

By ANDREW J. HARRIS | @andjpharris | Oct 10, 2019, 11:42am EDT

f t SHARE

WHEELS These High-Tech Sensors May Be the Key to Autonomous Cars



AdaSky's Viper cameras use far infrared sensors to create a more accurate picture for autonomous vehicles. [AdaSky](#)

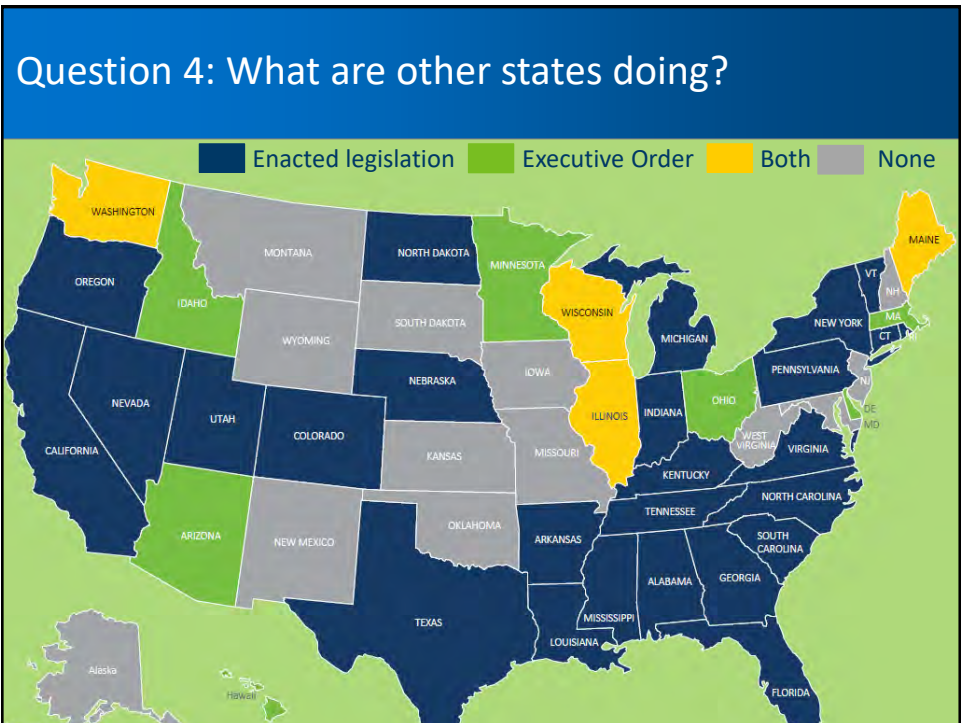
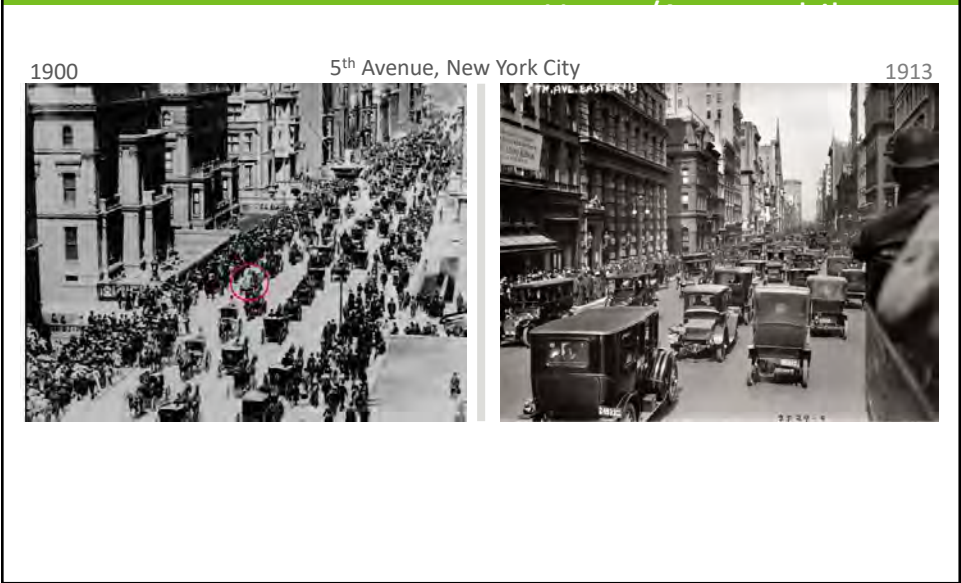


Question 3: Why is it taking so long?

- CAV will take time
 - Cruise Control
 - Adaptive Cruise Control
 - Lane Keeping
 - Blind Spot Warning
 - Emergency Breaking
 - SuperCruise/AutoPilot

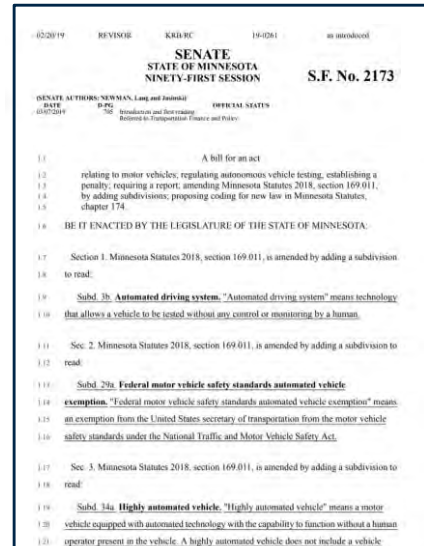


Question 3: Why is it taking so long?



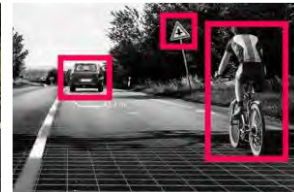
Question 5: How does policy need to change and how can we change it?

- Legalize AV testing and deployment
- Education
- Flexible and nimble policies that can adapt to rapidly advancing technology



Question 6: How can we advance CAV technology?

- Road environment – improve visibility of signs and pavement markings
- Accurate mapping – improve standard GPS technology
- Research and testing
- Public-private partnerships



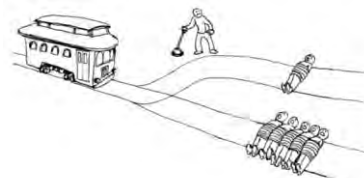
Question 7: How should we educate communities??

- Discuss the levels of automation
- Meet communities where they are at
- Pair education with demonstrations
- Surveys and feedback to inform policy



Question 8: What new safety challenges will emerge?

- Ethical programming
- Social behaviors
- Cyber security
- New failure modes



Question 9: Who will have access to CAVs?

- How much will they cost?
- Will everyone have access?
- How do we ensure CAVs expand opportunity and do not increase disparities?
- Will you need a driver's license?



Question 10: Who will be responsible?

- Are auto manufacturers liable?
- Do we have to sue the owner of each piece of technology?
- Is the owner responsible?
- How do we get crash data?
- Will insurance rates decrease or increase?





DESTINATION CAV

THE FUTURE OF MOBILITY
COMES TO MINNESOTA

Thank you



Kristin White, JD | Executive Director | MnDOT CAV-X
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Other Questions: Will CAVs increase congestion?

- Will they decrease congestion?
- “Ghost cars”?
- Zero occupant vehicles?
- Driving no longer lost time?
- Need for congestion pricing?
- Will they lead to exurban sprawl?
- Will they impact transit?



Other Questions: Who are the major players?

- Automotive manufacturers
Ford, GM, Audi, BMW, Honda, Tesla etc.
- Original Equipment Manufacturers (OEM)
Aptiv, Bosch, Continental AG, etc.
- Tech companies
Google/Waymo, Apple, Baidu, Intel, Nvidia, Uber, Lyft, Amazon, etc.
- How are the US DOT, MnDOT, law enforcement and safety advocates involved?



Other Questions: How can I get involved?

- Understand how CAV impacts TZD
- Watch this space
- Stay informed
 - T3 Forum hosted by SRF and Minnesota Guidestar
 - MnDOT demonstrations and events

