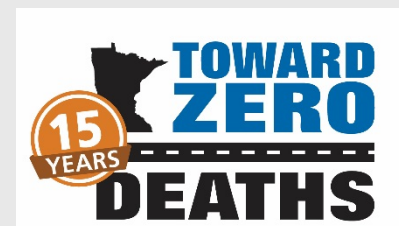




Autonomous and Connected Vehicles

Jay Hietpas

Connected and Automated Vehicle Director



Presentation Overview

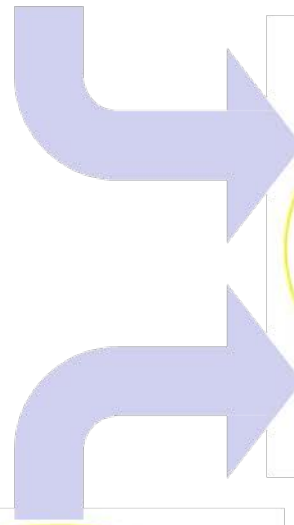
- Connected and Automated (CAV) Background
- What we know and don't know
- MN CAV Activities



Connected Automation

Autonomous Vehicle

Operates in isolation from other vehicles using internal sensors



Connected Automated Vehicle

Leverages autonomous and connected vehicle capabilities

Connected Vehicle

Communicates with nearby vehicles and infrastructure





0

1

2

3

4

5

No
Automation

Driver
Assist

Partial
Automation

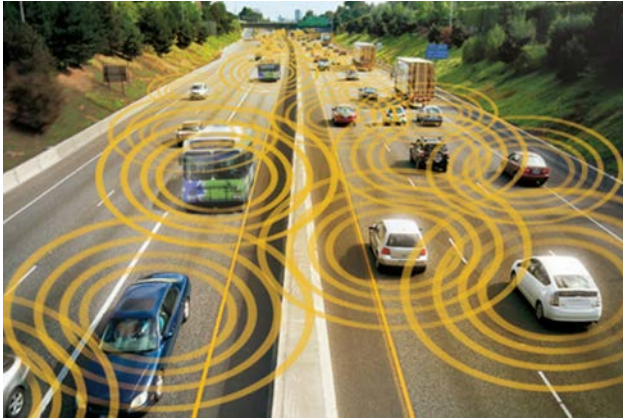
Conditional
Automation

High
Automation

Full
Automation

Society of Automotive Engineers (SAE) Levels of Automation

Items Being Considered

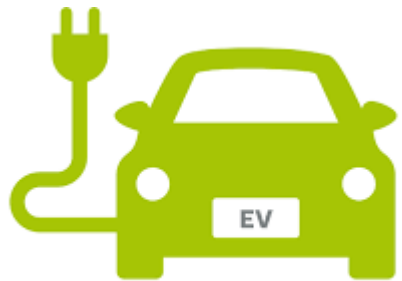


Automated & Connected Vehicles



Truck Platooning

Automated Delivery Services



Electric Vehicles



Mobility as a Service
(MAAS)



CAV - When Will It Come?

FORD TARGETS FULLY AUTONOMOUS VEHICLE FOR RIDE SHARING IN 2021; INVESTS IN NEW TECH COMPANIES, DOUBLES SILICON VALLEY TEAM

AUG 16, 2016 | PALO ALTO, CALIF.



CAV - When Will It Come?

GM will make an autonomous car without steering wheel or pedals by 2019

87

'Platoons' of autonomous Freightliner trucks will drive across Oregon

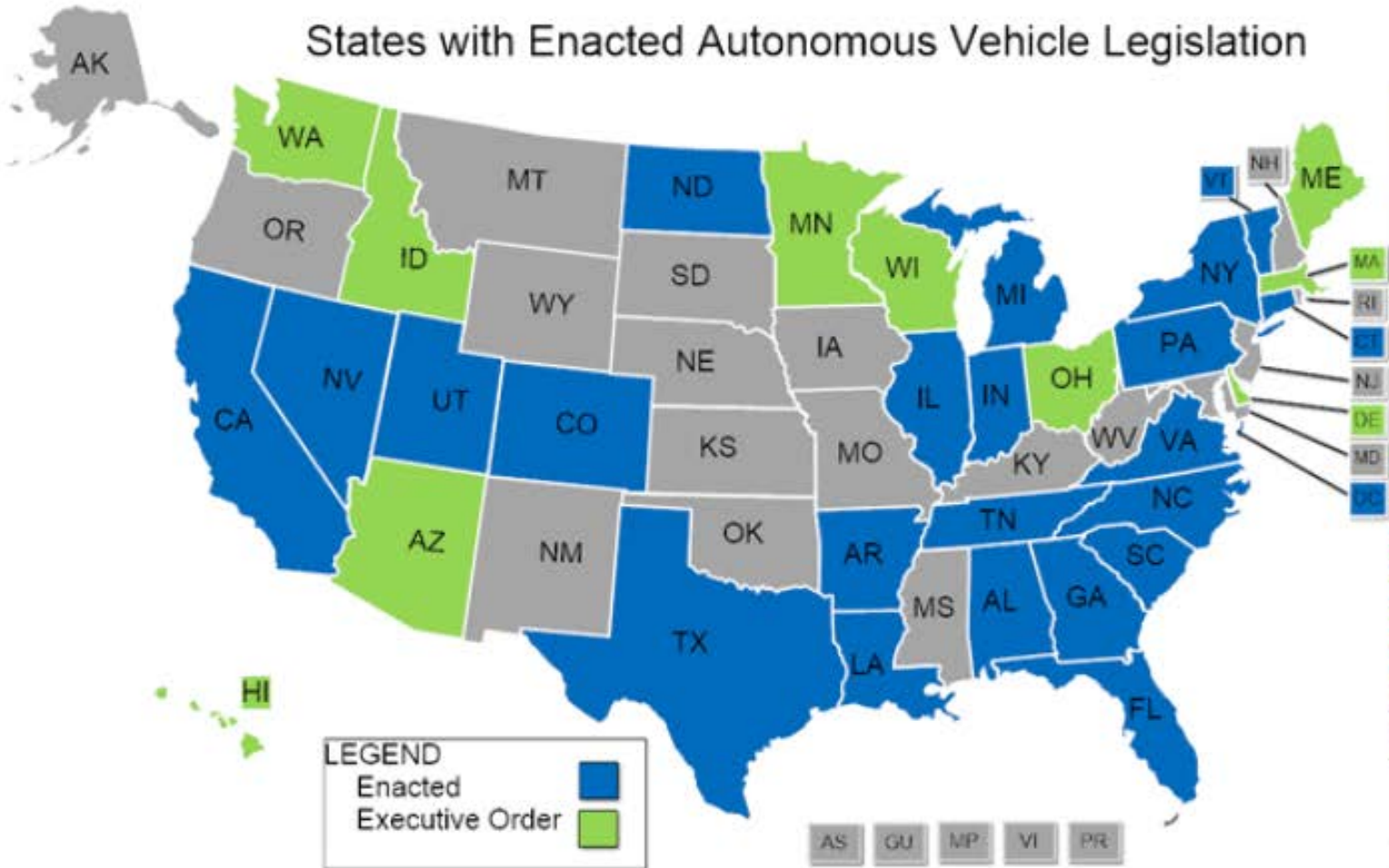
Uber signs deal to buy up to 24,000 autonomous vehicles from Volvo

Toyota and Lexus to introduce DSRC-based connected vehicles in the USA from 2021

Pieces of Automation Already Available

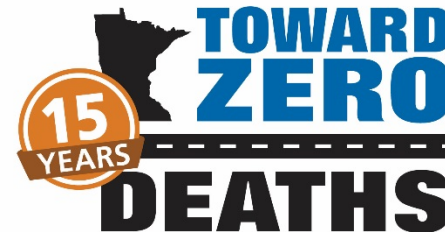
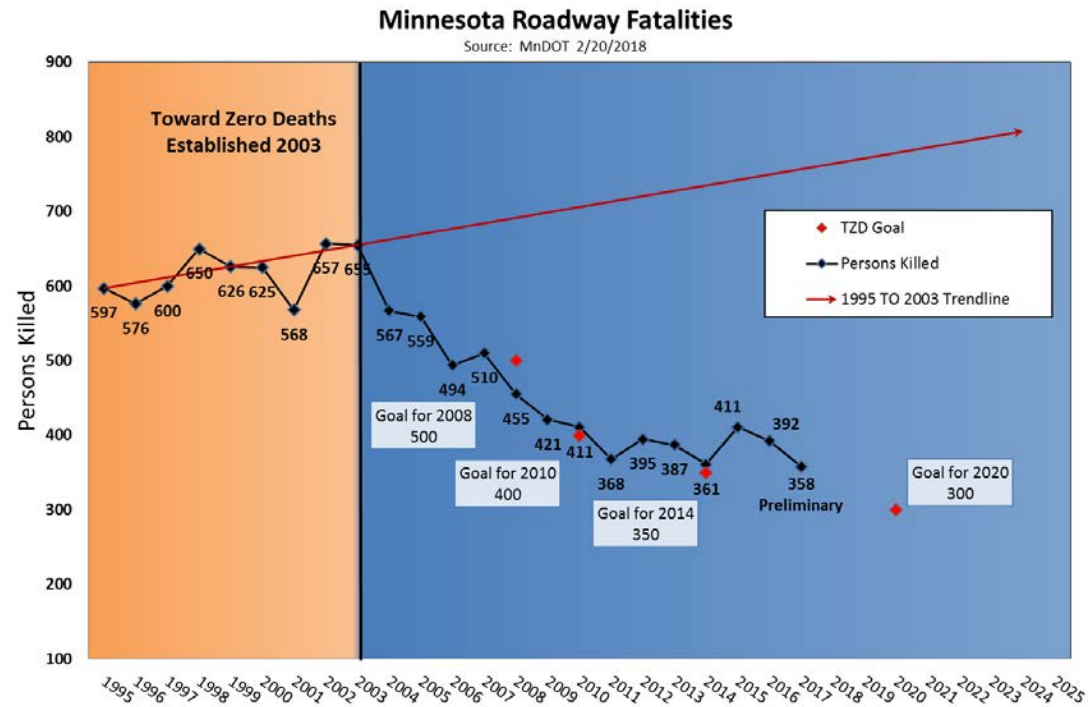
- Adaptive Cruise Control
- Self Parking Features
- Lane Departure Systems
- GM Super Cruise / Tesla Auto-Pilot
- V2I – Signal Systems (Audi, BMW, Apps)
- Self Driving Tests

National Items



What is the Impact to Minnesota?

- Safety
- Changes in operations
- Infrastructure Changes
- Regulation
- Mobility Opportunities
- Business Opportunities



Are We Ready?????



- 1. Are U.S. drivers comfortable with the idea of riding in a self-driving car?**
- 2. Are U.S. drivers comfortable with the idea of sharing the road with a self-driving car?**
- 3. Do U.S. drivers want semi-autonomous technologies in their next vehicle?**

Are We Ready????

Licensing
& Traffic
Laws

Revenue

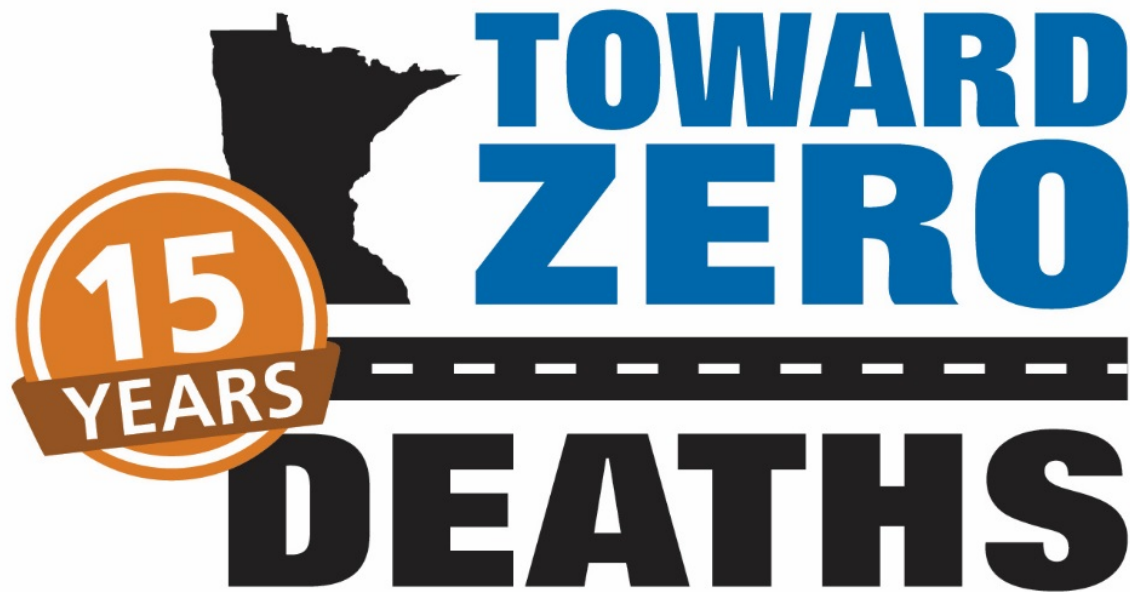
Cyber Security



Road
Infrastructure

Mixed Traffic
(AV & Non-AV)

Land Use / Planning



Enforcement

Education &
Outreach

Engineering

Emergency
Medical & Trauma
Services

Enforcement

- How do we know if the vehicle is operating in AV mode?
- Who is the responsible driver?
- Reacting to Law Enforcement
- Access to vehicle data
- Many, many more.....



- Regulation
 - Who is able to get a drivers license?
 - What type of insurance is needed?
 - What happens with all of our traffic safety laws?
 - Drivers need to know what the car can / can't do
- How do AV and Non-AV Work Together?
- How does AV change our approach to traffic safety challenges?

Engineering

- How do operations and traffic volumes change?
- What infrastructure is needed for AV and CV to operate?
- What does our future infrastructure look like?
 - Geometrics?
 - Safety Standards?
 - Transfer Facilities (trucks, cars, bikes, ped)
 - Signing and pavement marking standards



Emergency / Trauma Services

- How do I deal with an AV vehicle?

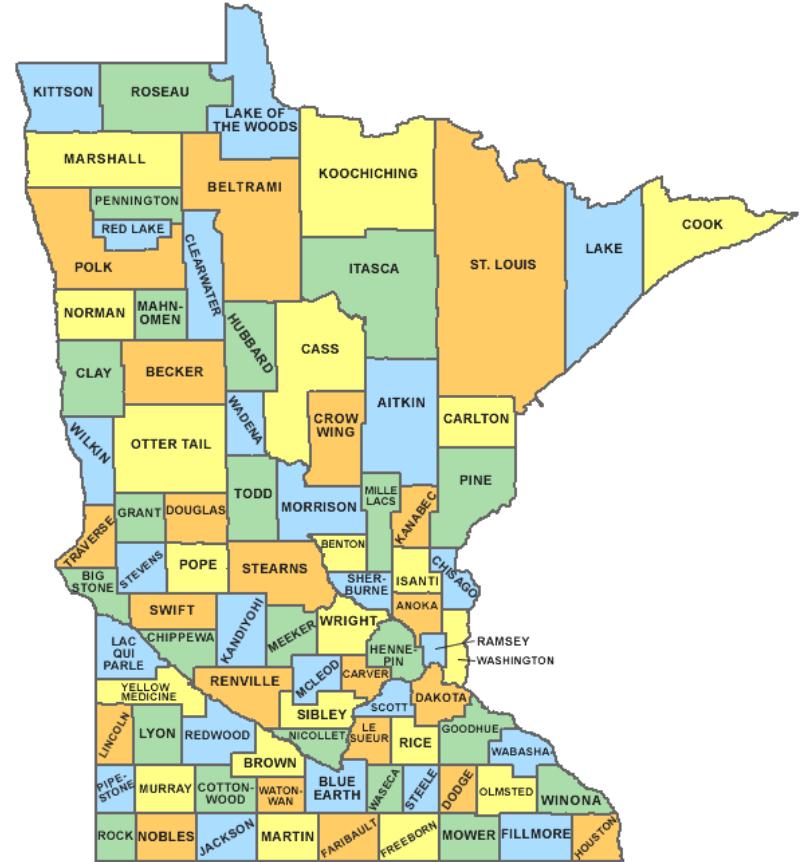


What is Happening in Minnesota

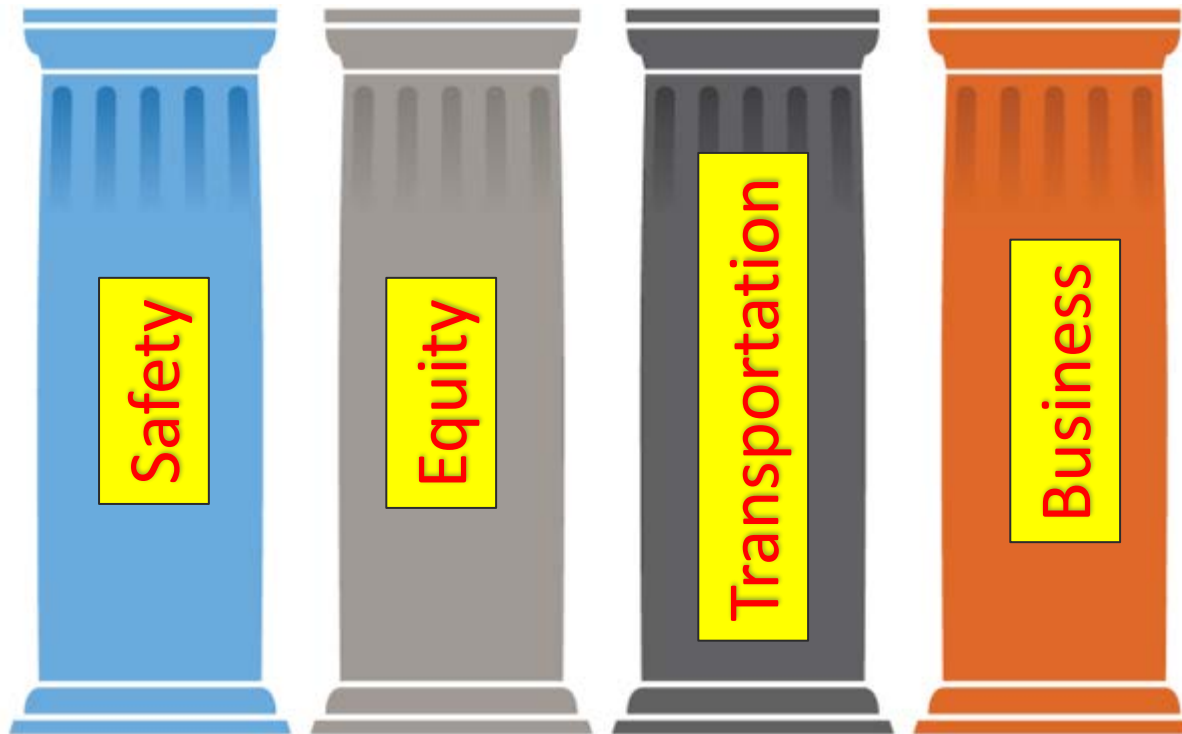
Policy

Testin

g



Executive Order 18-04 Advisory Council on Connected and Automated Vehicles



Advisory Council

I-CAV Team

Transportation
Infrastructure

Cyber security and
data privacy
standards

Vehicle
Registration,
Driving Training,
Licensing

Insurance

Traffic Regulations

Economic &
Workforce
Development,
Business
Opportunities

Accessibility and
Equity

MnDOT, DPS and Other Agencies

- Establish programs for development, testing, and deployment;
- Support safe and effective testing and use of Connected and Automated Vehicles (CAV); and



MnDOT CAV Strategic Vision



Safe Automated Vehicle Testing Demonstration

Project Goals

Snow and Ice Testing

Identify Infrastructure

Identify Operations Impacts

Improve Future Mobility Options

Increase Minnesota's Influence

Develop Partnerships

Public Feedback



Project Phases

Phase 1

- Testing at MnROAD

Phase 2

- Operation during Super Bowl week
- Open to the public

Phase 3

- Additional tests/demonstrations
- Investigating public & private partnerships for demonstrating in an operational setting

Demonstration Observations

- **Conditions:**

- Clear Weather / Bare Pavement
- Uncontrolled Weather
- Controlled Weather

- **Introduced Variables:**

- Shuttle Bus Only
- Obstacles (Work Zone Barrel)
- Other Cars, Pedestrians, Bicycles





Wheel Wander Accuracy

- 3mm – 1 cm



Interaction with Pedestrians

More conservative with higher speeds



Front Stop Distance = 5.3 – 6.6 Ft. (Bumper to Shins)
Side of Bus = 1.6 – 1.8 Ft. (off Wheel Path)

Interaction with Other Cars



Downtown Minneapolis - Nicollet Mall Demo

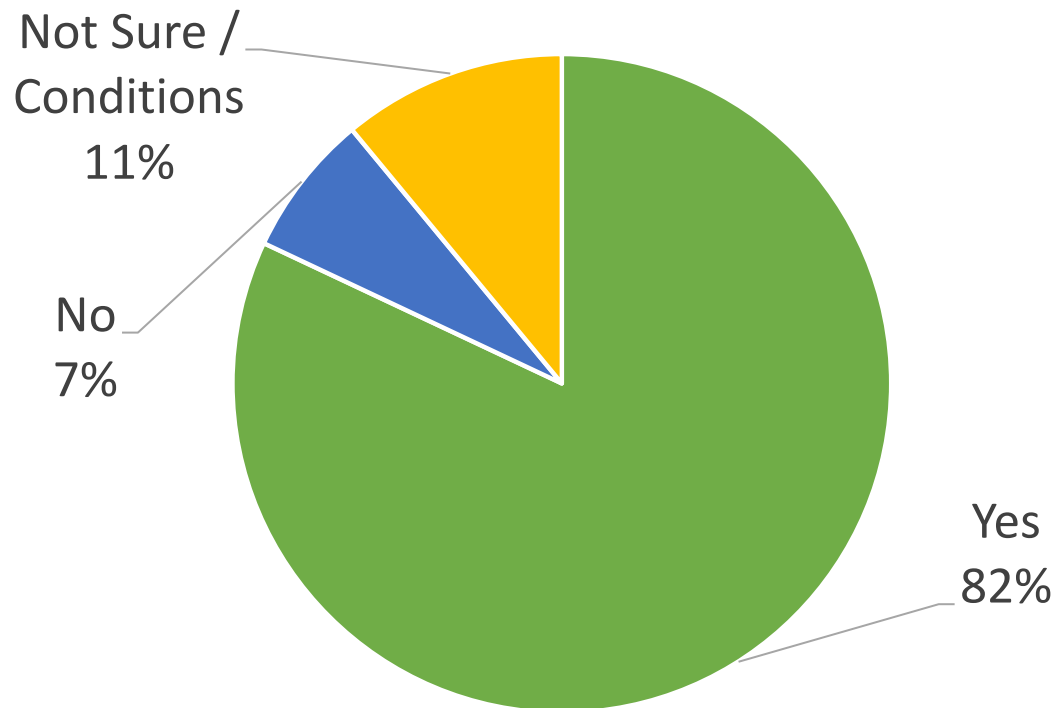


TOTAL riders for the 3 day demo: **1279**

Survey Responses

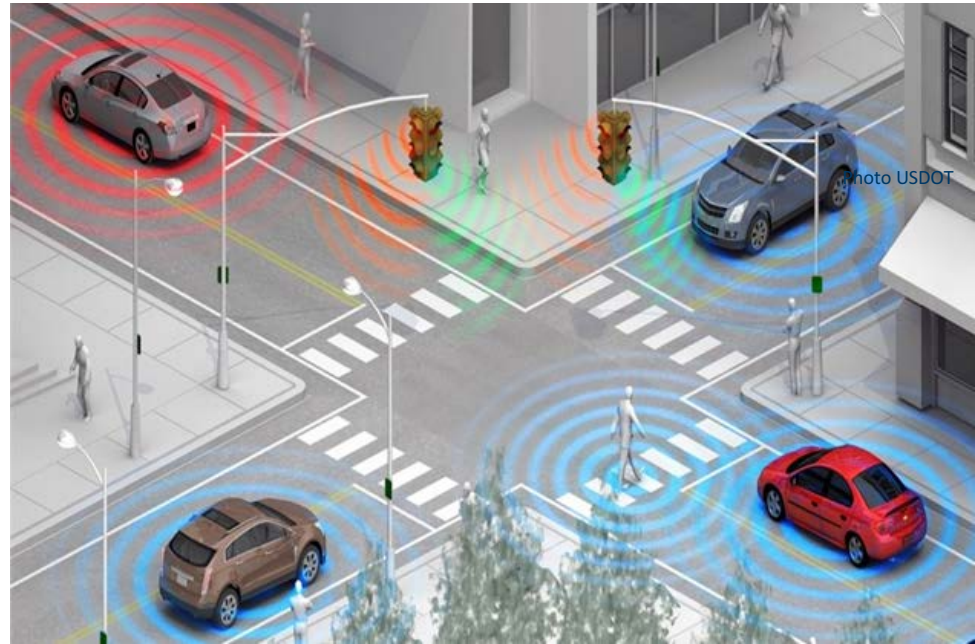


Q: Are you looking forward to having driverless vehicles operate on all roadways in the future?



Planned “Connected Corridor”

- I394, Hwy 55, Hwy 7
- SPaT
- Send/Receive BSM
- Pedestrian Assistance
- Data Sharing
- Cyber Security



Thank you again!

<http://www.dot.state.mn.us/automated/index.html>

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651-234-7004