Innovation in Action
Cooperative Automated Transportation (CAT)

WSDOT's efforts to prepare for connected and automated vehicles

Ted Bailey, Cooperative Automated Transportation, Program Manager
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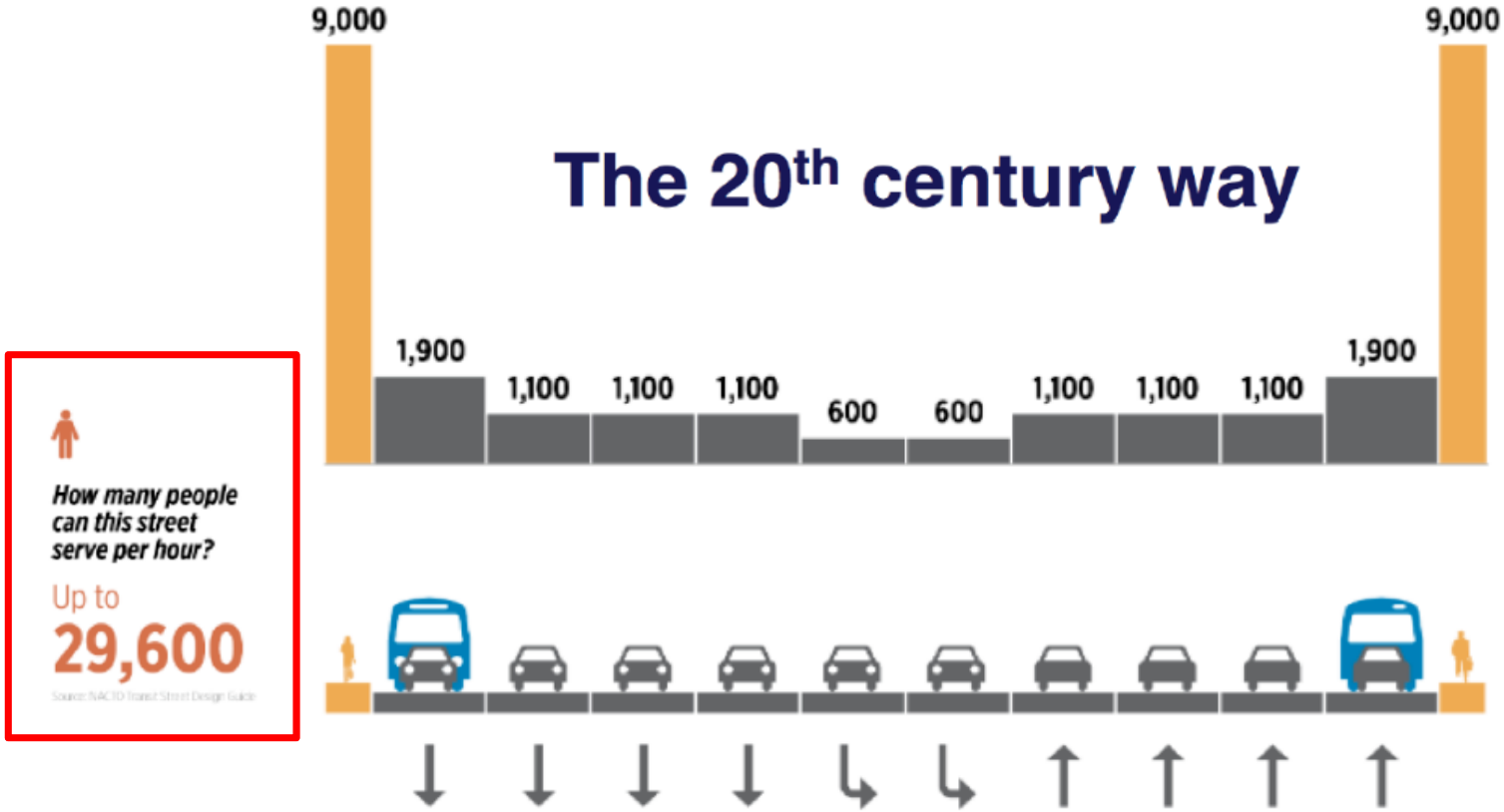
Washington State Department of Transportation
Webinar, September 12th, 2018, 10:30-11:30 a.m.

Version: 9-11-18, 11am

Do our old standards meet today's demands?



What if we tried to “solve” congestion by adding lanes?

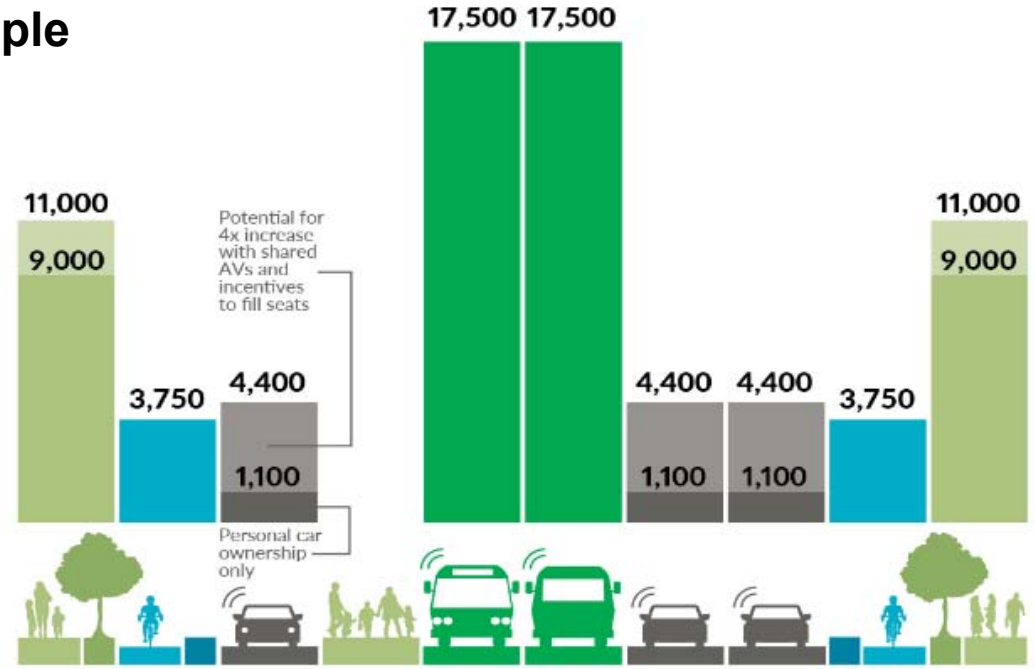
Additional interstate miles needed to drive posted speed limit at all times in WA State:

- **451 lane miles at an estimated cost of $115 billion**
- Would require a **$2.20 to $2.50/gal gas tax increase**

Note: Assuming no one else moves to Washington and there is no increase in demand

A new way to look at our transportation system

If we manage the asphalt and concrete, we can move more people



Are we focused on:

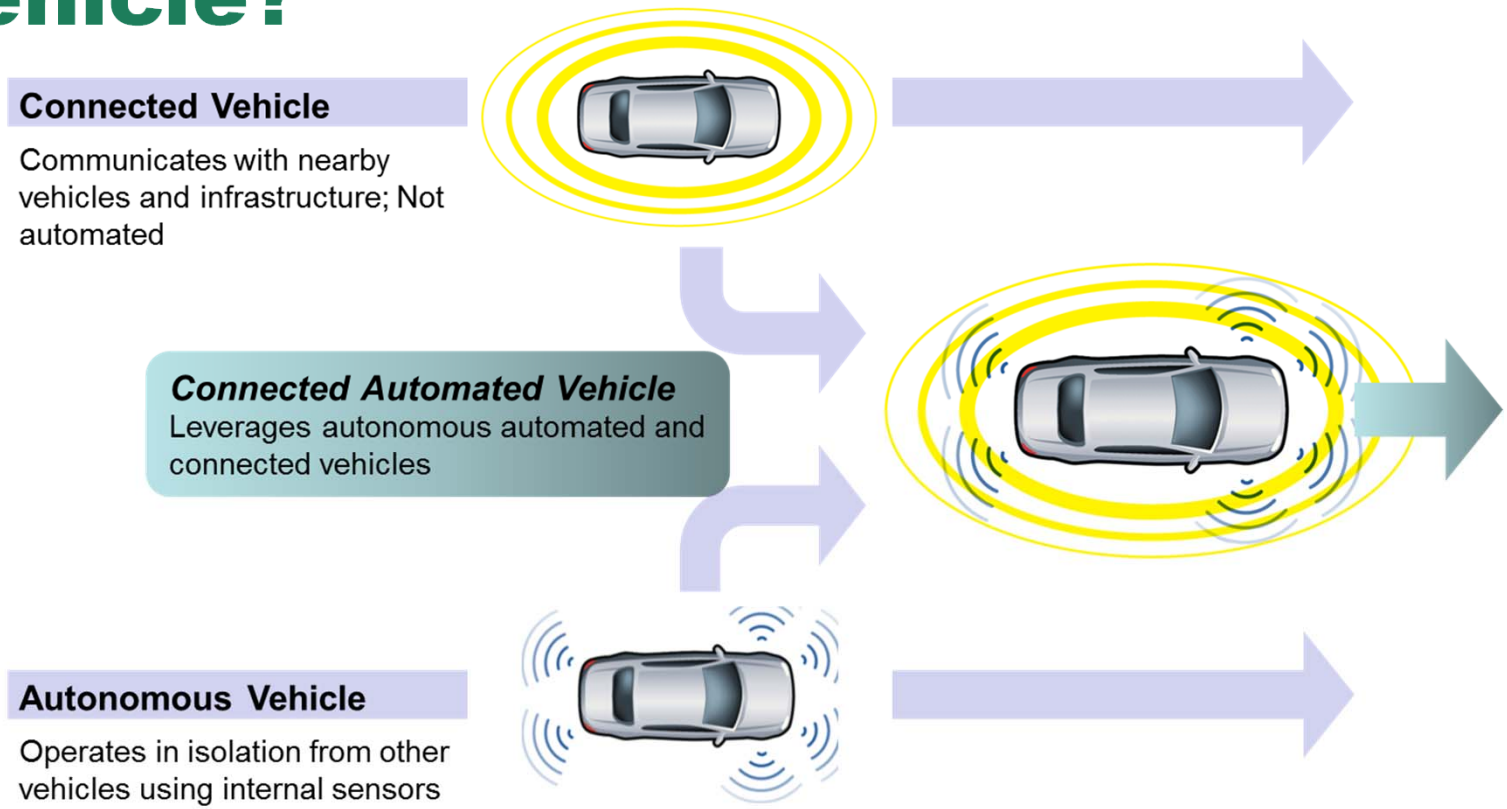
Replacing the human driver with a robot?

or

Enhancing the lives of the people we serve?

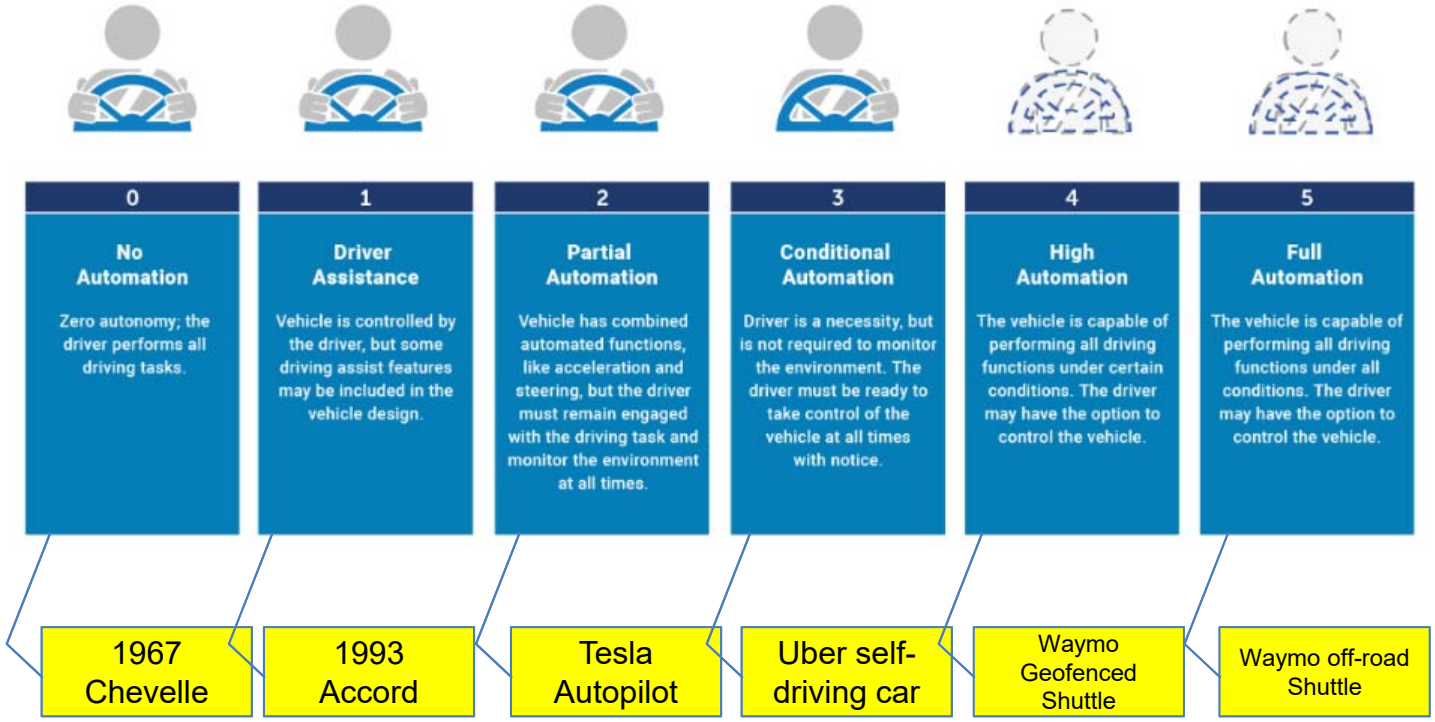
When will Connected Automated Vehicles Arrive?

What is a Connected Automated Vehicle?



What is a Connected Automated Vehicle?

SAE: Society of Automotive Engineers



Automobile history

Easter Parades in New York City

Year 1900: One Motor Vehicle

Year 1913: One Horse & Carriage

So when will “Autonomous” Vehicles arrive?

Telsa has stated publically their current models are SAE Level 5 ready today ….. from a hardware standpoint

What is missing? Software and consistent nationwide Legislation

In the future Tesla owners will be able to go to Level 5 with a software upgrade.

So when will “Autonomous” Vehicles arrive?

Nine competitors have publically projected market dates between 2019 and 2022 for SAE Level 5 Vehicles

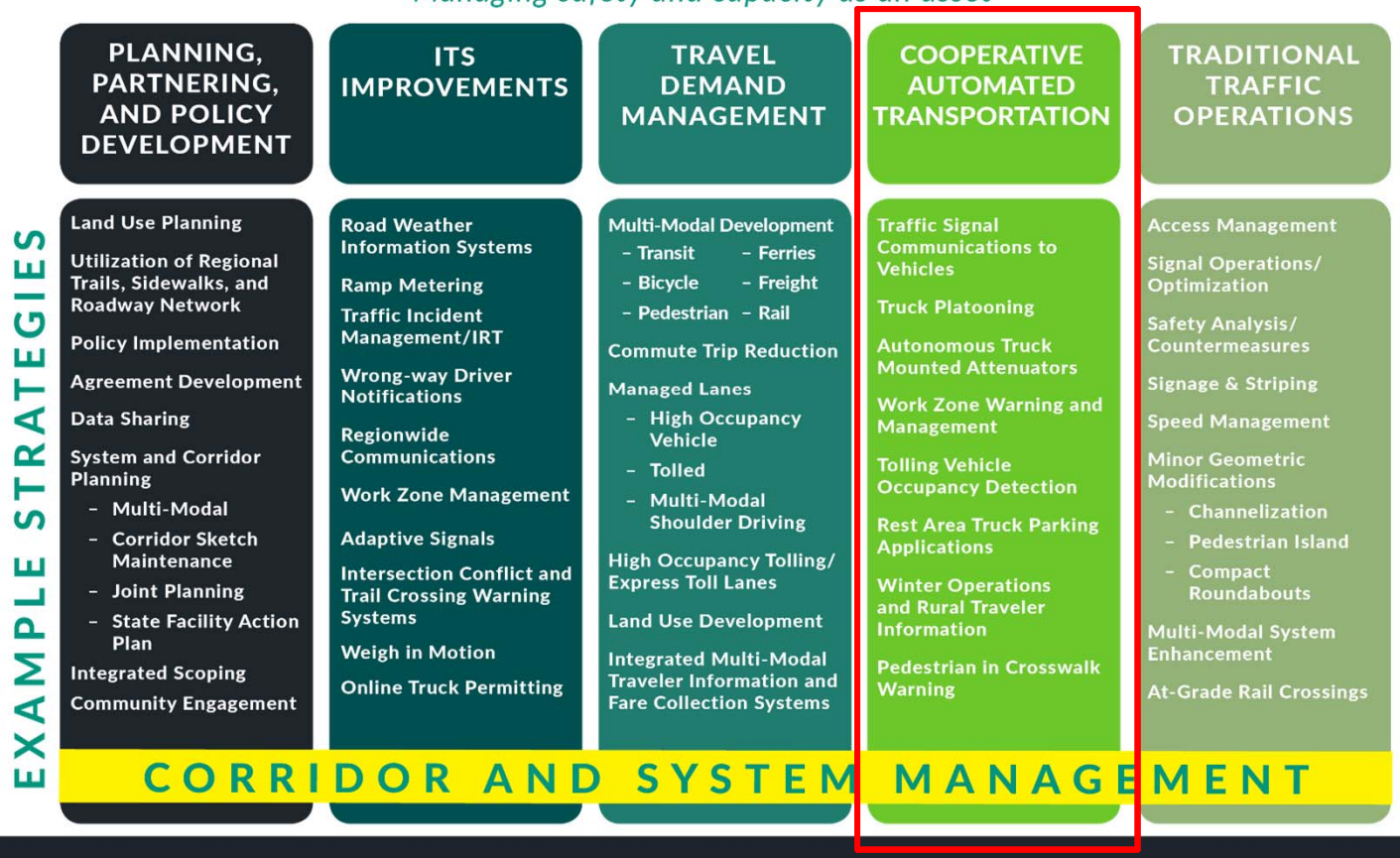
Source:

Organizational Efforts

CAT is a part of TSMO within WSDOT

Transportation Systems Management & Operations (TSMO)

Managing safety and capacity as an asset



WSDOT organizational efforts

Secretary of Transportation

Assistant Secretary
Multimodal Development
& Delivery

External Workgroups

Governor's Autonomous Vehicle Work Group

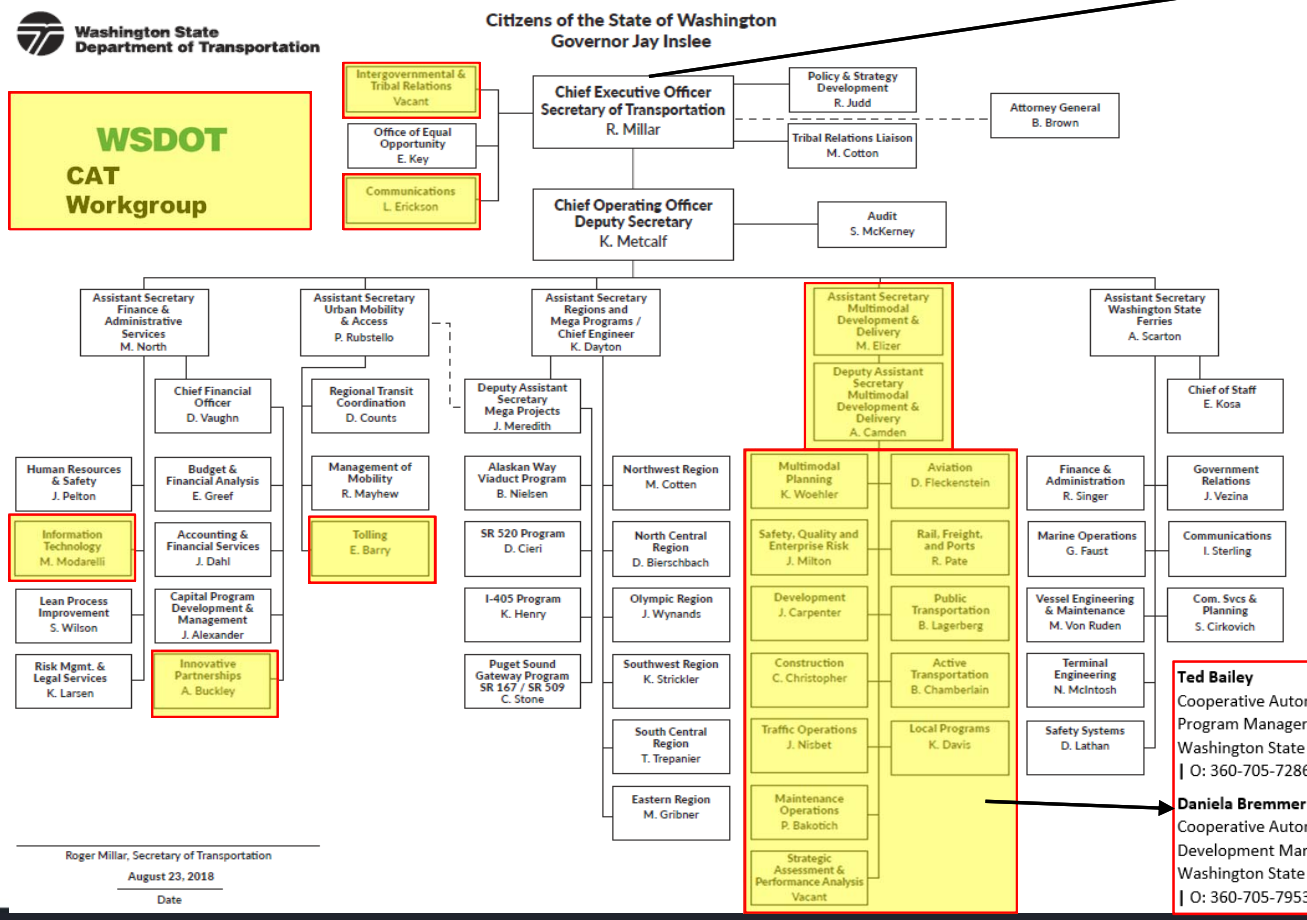
Washington State Transportation Commission
Washington State Autonomous Vehicle Work Group

AASHTO CAT Coalition

Policy, Legislative, and Regulatory Workgroup

ITS AMERICA

WSDOT Organizational Efforts



External Workgroups

Governor's Autonomous Vehicle Work Group

Washington State Transportation Commission
Washington State Autonomous Vehicle Work Group

AASHTO CAT Coalition Policy Legislative and Regulatory Workgroup Chair

ITS AMERICA

Two dedicated Traffic Operations Division staff leading the WSDOT CAT Workgroup

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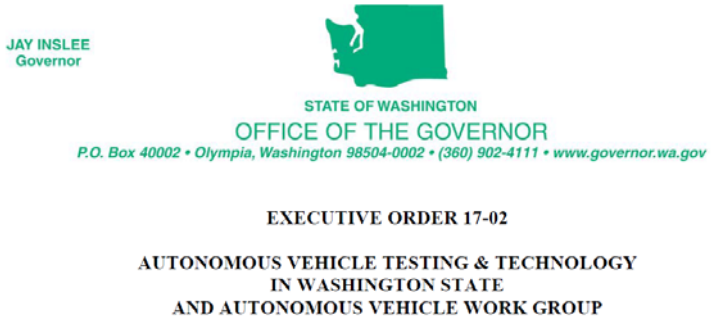
How is Washington state preparing?

Governor's Autonomous Vehicle Work Group



JAY INSLEE
Governor

STATE OF WASHINGTON
OFFICE OF THE GOVERNOR
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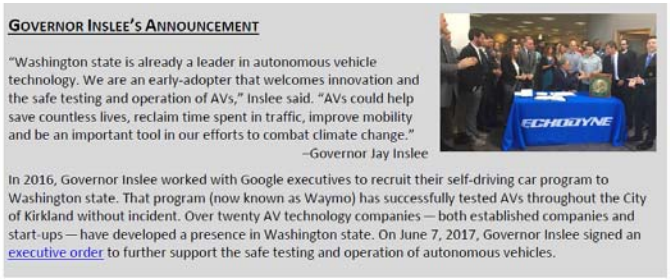
EXECUTIVE ORDER 17-02

AUTONOMOUS VEHICLE TESTING & TECHNOLOGY
IN WASHINGTON STATE
AND AUTONOMOUS VEHICLE WORK GROUP



GOVERNOR INSLEE'S ANNOUNCEMENT

"Washington state is already a leader in autonomous vehicle technology. We are an early-adopter that welcomes innovation and the safe testing and operation of AVs," Inslee said. "AVs could help save countless lives, reclaim time spent in traffic, improve mobility and be an important tool in our efforts to combat climate change."
–Governor Jay Inslee

In 2016, Governor Inslee worked with Google executives to recruit their self-driving car program to Washington state. That program (now known as Waymo) has successfully tested AVs throughout the City of Kirkland without incident. Over twenty AV technology companies — both established companies and start-ups — have developed a presence in Washington state. On June 7, 2017, Governor Inslee signed an executive order to further support the safe testing and operation of autonomous vehicles.

- June 7, 2017 Executive Order 17-02 formed Governor's AV Work Group

Washington State Transportation Commission
Washington State Autonomous Vehicle Work Group

- March 22, 2018 SHB 2970 Transportation Commission facilitated AV Work Group

Washington State Transportation Commission Autonomous Vehicle Workgroup

- Roadway infrastructure
- Traffic management
- Transit service & vehicles
- Advertising
- Right of way
- Multi-modal transportation
- Mobility as a service

- Governor
- Insurance Commissioner
- Department of Licensing
- Department of Transportation
- Washington State Patrol
- Traffic Safety
- Commission
- State Chief Information Officer
- WSTC Chair
- Four members from Senate
- Four members from House

Washington State Transportation Commission

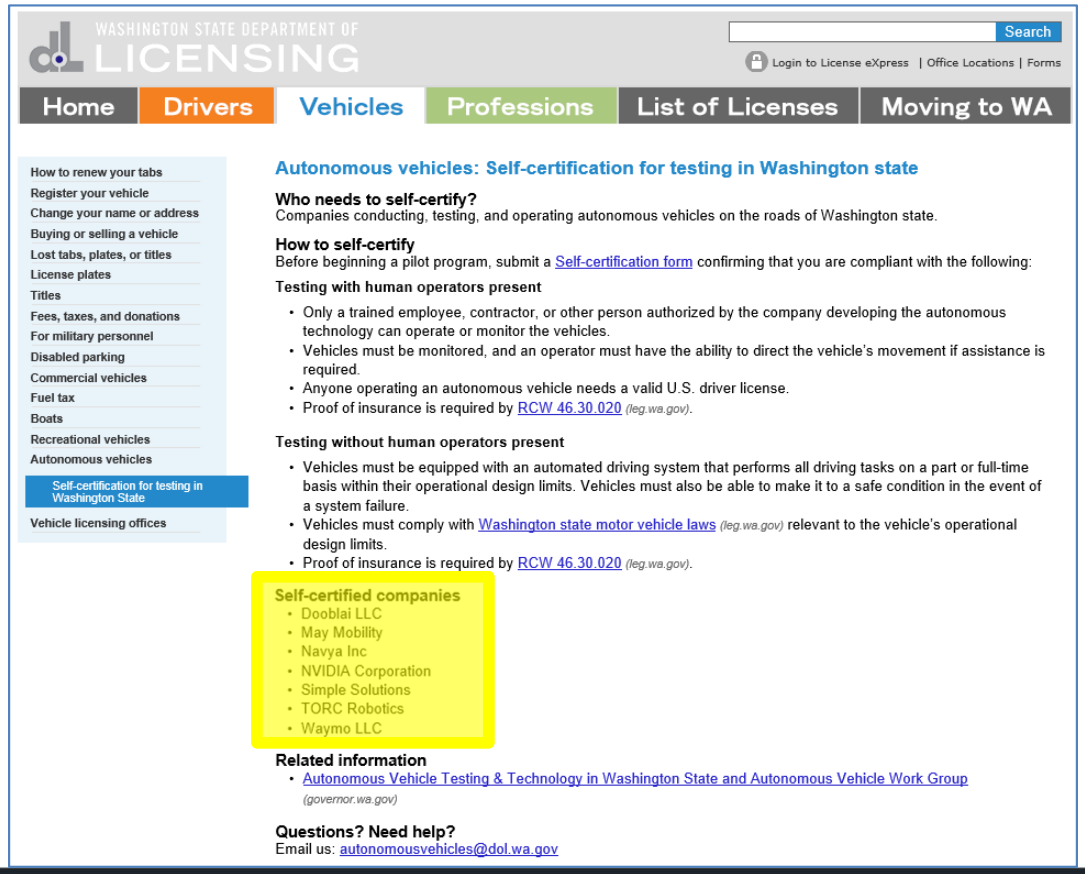
Washington State Autonomous Vehicle Work Group

www.wstc.wa.gov/Meetings/AVAgenda/AutonomousVehicleWorkGroup.html

Subcommittees

- Licensing
- Infrastructure and Systems
- Liability
- Safety
- System Tech and Data Security

On-road testing and deployment in Washington



WASHINGTON STATE DEPARTMENT OF LICENSING

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License plates
Titles
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Commercial vehicles
Fuel tax
Boats
Recreational vehicles
Autonomous vehicles
Self-certification for testing in Washington State
Vehicle licensing offices

Autonomous vehicles: Self-certification for testing in Washington state

Who needs to self-certify?
Companies conducting, testing, and operating autonomous vehicles on the roads of Washington state.

How to self-certify
Before beginning a pilot program, submit a Self-certification form confirming that you are compliant with the following:

Testing with human operators present

- Only a trained employee, contractor, or other person authorized by the company developing the autonomous technology can operate or monitor the vehicles.
- Vehicles must be monitored, and an operator must have the ability to direct the vehicle's movement if assistance is required.
- Anyone operating an autonomous vehicle needs a valid U.S. driver license.
- Proof of insurance is required by RCW 46.30.020 *(leg.wa.gov)*.

Testing without human operators present

- Vehicles must be equipped with an automated driving system that performs all driving tasks on a part or full-time basis within their operational design limits. Vehicles must also be able to make it to a safe condition in the event of a system failure.
- Vehicles must comply with Washington state motor vehicle laws *(leg.wa.gov)* relevant to the vehicle's operational design limits.
- Proof of insurance is required by RCW 46.30.020 *(leg.wa.gov)*.

Self-certified companies

- Dooblai LLC
- May Mobility
- Navya Inc
- NVIDIA Corporation
- Simple Solutions
- TORC Robotics
- Waymo LLC

Related information

- Autonomous Vehicle Testing & Technology in Washington State and Autonomous Vehicle Work Group *(governor.wa.gov)*

Questions? Need help?
Email us: autonomousvehicles@dol.wa.gov

Department of Licensing Autonomous Vehicles: Self-certification testing in Washington state

Self-Certified Companies

1. Dooblai LLC
2. May Mobility
3. Navya Inc.
4. NVIDIA Corporation
5. Simple Solutions
6. TORC Robotics
7. Waymo LLC

AASHTO Policy, Legislative and Regulatory Work Group
Work Plan Priorities through June 2019

Activity #1: Create a clearinghouse for sharing CAT policy frameworks completed or under development

Activity #2: Identify funding opportunities and financing models to enable near-term CAT investments

Activity #3: Identify model regulations that enable near-term pilots and deployments

Top Priorities

1.) Guidelines for AV testing on public roads
2.) Truck platooning – driver assisted (SAE Level 1)
3.) HOV lane enforcement

WSDOT Draft CAT Policy Framework

How does WSDOT define CAT?

Cooperative: Deploying technology to encourage all modes of transportation to work in concert to provide travelers a safe, sustainable, and integrated multimodal transportation system.

Automated: By automating some or all of the functions of or access to various vehicle types (automobile, van, plane, truck, bus, rail, ferry, bicycle, scooter, etc.), traffic management systems, integrated multimodal trip planning and pavement systems along with other functions of the transportation system will greatly improve our collective ability to leverage our limited funding to get the most capacity and safety out of the entire multimodal transportation system.

"Autonomous" implies independence, when in reality all of the parts of the transportation system are interdependent."

Transportation: The entire transportation system working together (vehicles, infrastructure, modes, services, etc.) to provide safe, reliable and cost-effective transportation options to make our communities more livable, improve economic vitality, and improve the safety of our entire multimodal transportation system.

WSDOT draft CAT policy framework

Vision

We envision a future where automated, connected, electrified, and **shared mobility** contributes toward a **safe** and efficient transportation system that **emphasizes public transit and active transportation** and promotes **livable (walkable / bikeable), economically vibrant communities** with affordable housing and convenient access to jobs and other activity centers.

WSDOT draft CAT policy framework

Proposed Draft CAT policy goals

- Organizing for innovation
- Shared mobility
- Economic vitality and livability
- Infrastructure and Context Sensitive street design
- Land use
- Equity
- Safety
- Environment

Organizing for innovation

Draft CAT Policy Goal: Technologies associated with CAT provide the opportunity to revolutionize the way transportation systems are provided and maintained in Washington state. WSDOT should frame its deployment of CAT so it can flexibly and quickly adapt to changes in technology and transportation advancements to maintain its role as a national leader in this space.

Shared mobility

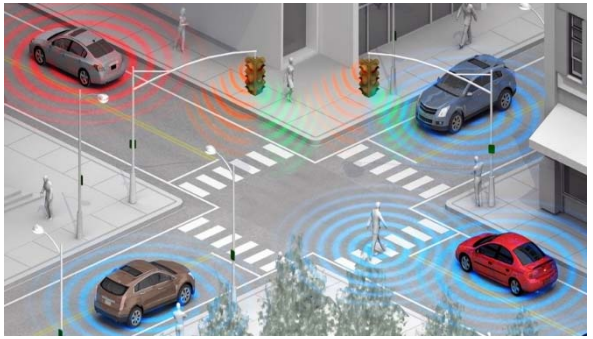
Draft CAT Policy Goal:
In order to minimize traffic congestion and urban sprawl with the deployment of CAT, WSDOT and its partners should encourage and incentivize shared mobility. Particular emphasis should be given to buttress effective and convenient high-capacity public transit.

Economic vitality and livability

Draft CAT Policy Goal:
Implementation of CAT should enhance WSDOT's local partners' plans to enhance economic vitality and livability. WSDOT should emphasize automated, connected, and electric mobility to optimize system efficiency and provide greater and more direct access to jobs, economic centers, and other valued destinations.

Infrastructure and Context Sensitive Street Design

Draft CAT Policy Goal: As we move into a future with increased autonomy and shared mobility, it is important to plan and design our transportation infrastructure with consideration for all modes. While balancing the needs of automated passenger vehicles, our transportation system will safely and efficiently accommodate pedestrians, bicyclists, public transportation, and freight.



Land use

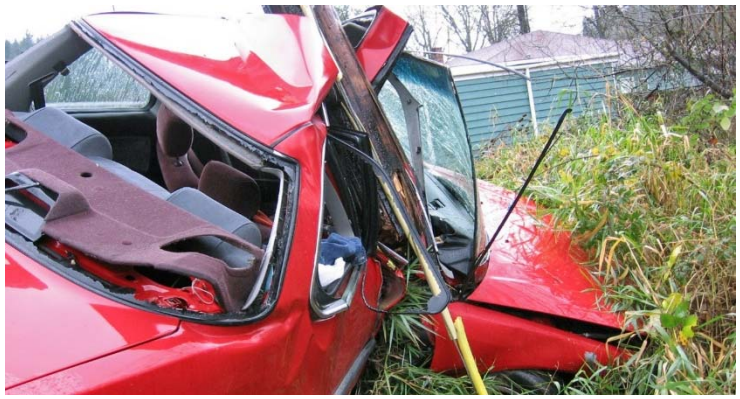
Draft CAT Policy Goal: The implementation of CAT should advance state, regional, and local land use goals. WSDOT is committed to encouraging development of dense, vibrant, and transit-oriented communities in urban areas while preserving and enhancing rural and resource lands. Implementation of CAT should not incentivize urban sprawl. Land use and growth management decisions implemented by state statue along with local government policies and ordinances will need to be coordinated in new ways in order to achieve the vision of this CAT policy framework.

Equity

Draft CAT Policy Goal: Deployment of CAT should ensure the benefits of automated mobility are equitably distributed across all segments of the community and that the negative impacts of automated mobility are not disproportionately borne on traditionally marginalized geographic or demographic communities.

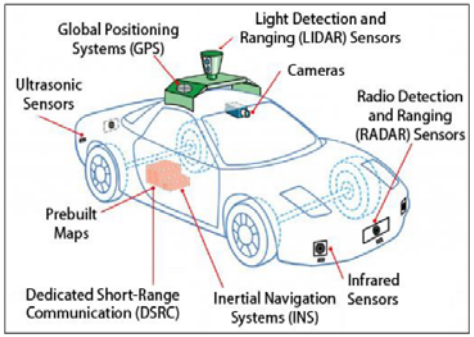
Safety

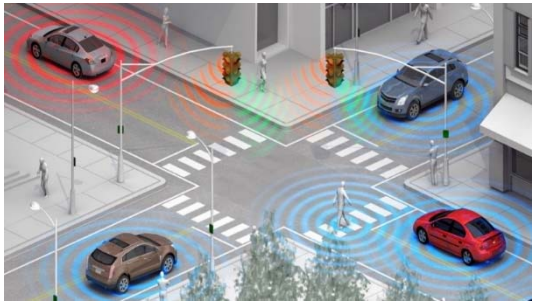
Draft CAT Policy Goal: Advanced driving systems and highly automated vehicles will be deployed in a manner that increases the safety and security of the transportation system and its users.



Environment

Draft CAT Policy Goal: Preserve and protect the environment through the implementation of CAT.





WSDOT's Current Investments and Future Opportunities

Multimodal Planning Division

- Incorporate CAT strategies and actions into short- and long-range planning documents.
- Share information with our partners
- Encourage our partners to plan for CAT technologies by communicating WSDOTs current investments and future opportunities
- Share guidance and best practices on optimizing urban spaces freed up by CAT strategies.
- Work to ensure CAT implementation promotes equitable access to jobs and housing.
- Identify CAT projects that support a sustainable transportation network.

Public Transportation Division

- Pierce Transit has been piloting:
  - Automated pedestrian detection which has reduced pedestrian-related crashes
  - Use of subsidized transportation network company (TNC) trips for first/last mile connections

- WSDOT is exploring
  - Rural micro-transit
  - First/last mile connections
  - Potential Grant Program

Tolling Division

- Automated Vehicle Occupancy Detection
- Integrated Transponders (V2I)

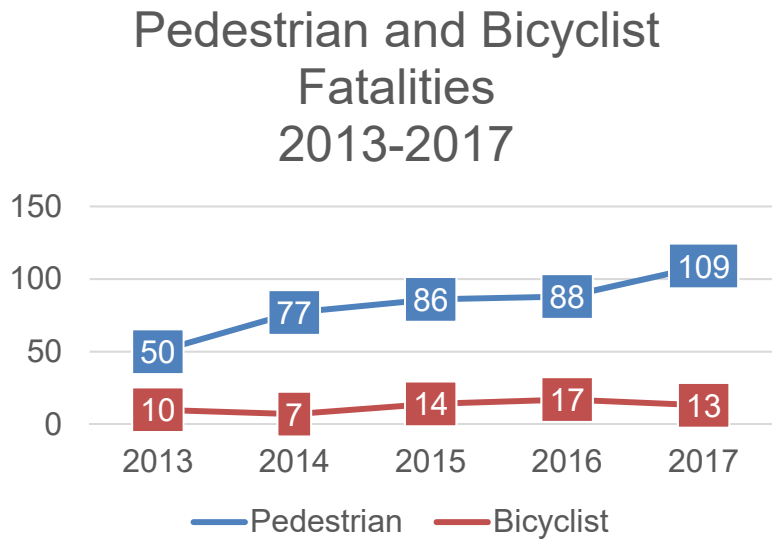
Active Transportation Division

- Update to the statewide Active Transportation Plan
- Network connectivity analysis
- Data collection

Lyft and Baltimore Bike Share together at a "transportation hub."

Active Transportation Division

- Infrastructure design recommendations
- Pedestrian Safety Action Plan
- E-bike + bikeshare policy and research partnerships



Rail, Freight, and Ports Division

- WSDOT has been working with:
  - International Mobility and Trade Corridor
  - Northwest passage Freight Task Force
  - Western States Freight Coalition

- Freight system optimization
  - Truck parking study
  - Proposed truck platooning pilot

Rail, Freight and Ports Division

Proposed Driver-Assistive Truck Platooning (DATP) Pilot

- As of September 2018, **17 states have made allowance for commercial deployment of driver-assistive truck platooning**. Sixteen have passed legislation (Alabama, Arkansas, Georgia, Indiana, Kentucky, Louisiana, Michigan, Mississippi, Nevada, North Carolina, Oregon, South Carolina, Tennessee, Texas, Utah, and Wisconsin), and one has acted administratively (Ohio).
- **Four other states** (Arizona, Colorado, Florida, and New Mexico) allow limited commercial deployments of truck platooning.
- **Three states** (California, New York, and Virginia) allow for testing of truck platooning, with others expressing interest.
- **Illinois and Pennsylvania** currently have legislation pending which would allow full commercial deployment of truck platooning.

Maintenance Division

Work Zone Safety

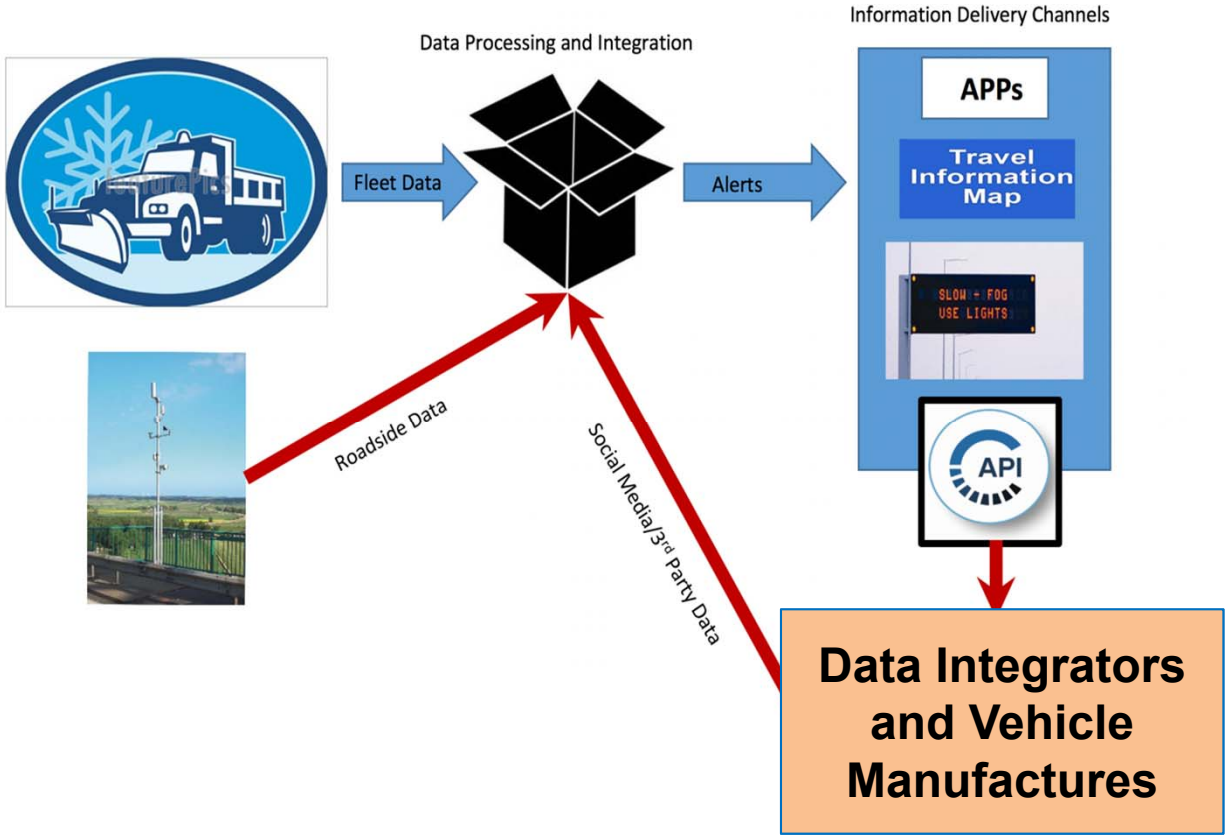
- Autonomous Truck Mounted Attenuator vehicle (A TMA)
- 2018 pilot with other states
- Considering low-speed striping operations

Maintenance Division

Testing the use of small Unmanned Aerial Systems (sUAS)

- Vegetation management
- Stockpile management
- Survey and inspection of roadside assets
- Video documentation of operations for training purposes

Maintenance Division - Winter Operations Pilot



Informing the public:
"Snow Plow Operations Ahead"

Maintenance and Traffic Operations Divisions

Machine readable signing and striping

"Good for human drivers today …

Prepares for Automated Vehicles tomorrow"

Traffic Operations Division

Communicating with the transportation infrastructure

Communicate via **centralized system**

AASHTO Signal Phase and Timing (SPaT) Challenge

- **4 locations across WA**
  - **23 intersections**

DSRC: Dedicated short range communications the vehicle to the traffic signal

Traffic Operations Division

I-5 Active Traffic Management Connected Vehicle Demo

Traffic Operations and Research Office

1

Preparing for Connected Vehicle Opportunities – UW

- Provide guidance on what CAV issues / technologies we should pursue as a State DOT in relation to Smart Cities.

2

Enhancing Roadway Safety and Operations – UW

- Collecting and sharing information between pedestrians, bicycles, transit vehicles and traffic signals to enhance safety and operations through DSRC

3

Preparing for changes in Traffic Signal Operations – WSU

- What locations would benefit from CV equipment first and how should we adjust traffic signal timing?

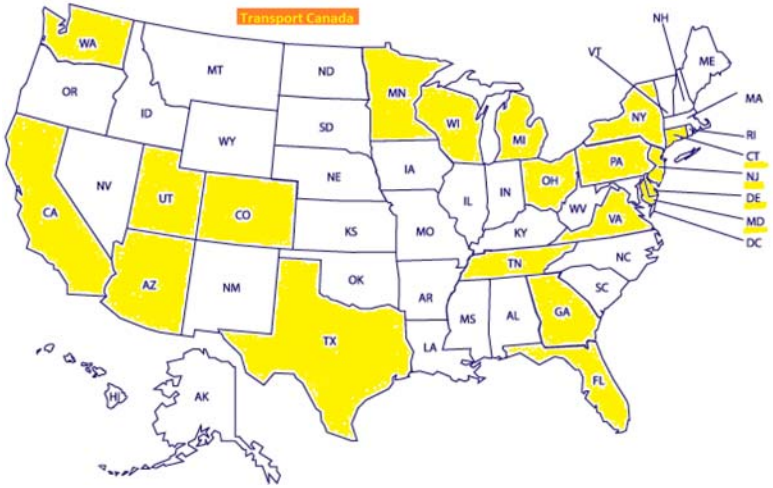
UNIVERSITY of WASHINGTON

WASHINGTON STATE UNIVERSITY

Traffic Operations and Research Office

Connected Vehicle(CV) Pooled Fund Study

- National program to facilitate field deployment of equipment and systems that connect the highway infrastructure to vehicles
- FHWA, 20 States, Transport Canada, several other jurisdictions and representation from the auto industry
- Owner/operator group with a technical focus



Development Division / Research Office

- Bringing together public, private, and research organizations to share perspectives on critical issues surrounding the deployment of automated vehicles and shared mobility

The National Academies of
SCIENCES • ENGINEERING • MEDICINE

FORUM MEETING #2: JULY 8-9, 2018; SAN FRANCISCO, CA

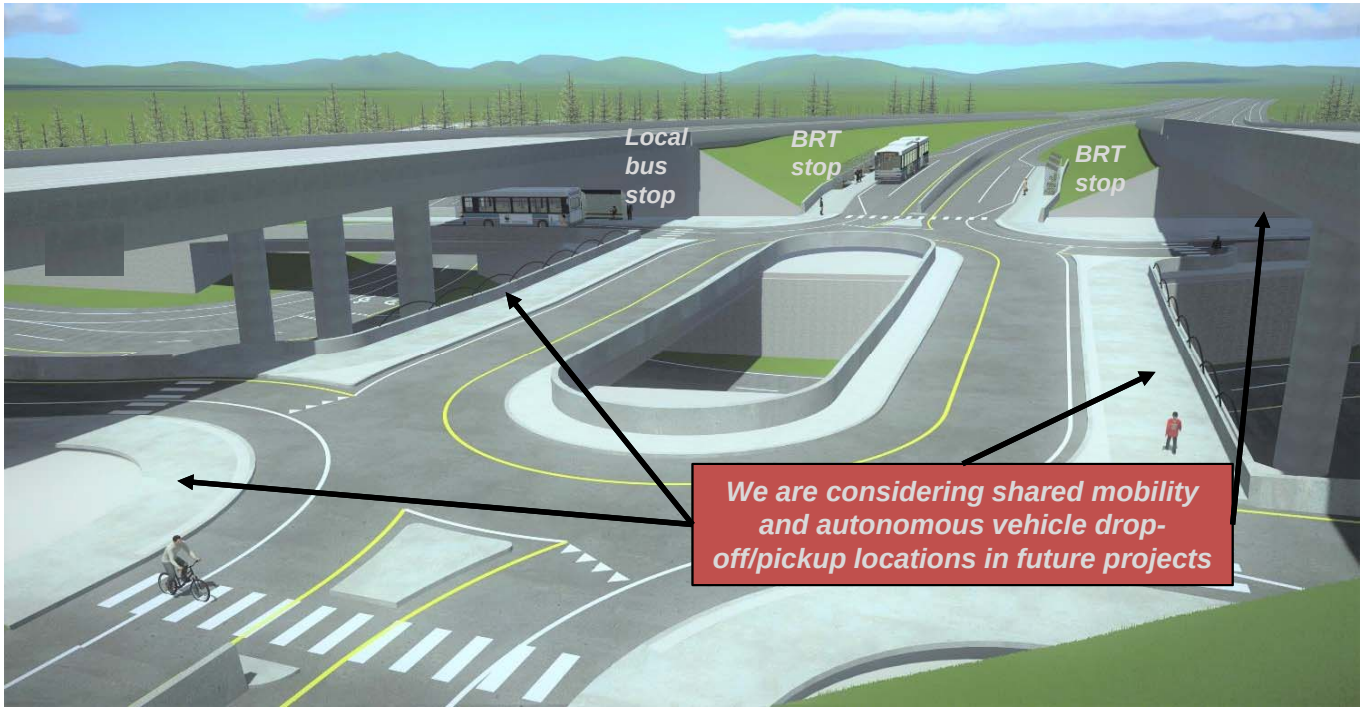
Forum on Preparing for Automated Vehicles & Shared Mobility

The National Academies of
SCIENCES • ENGINEERING • MEDICINE
TRB
TRANSPORTATION RESEARCH BOARD

Development Division

Preparing for Transit Connectivity

- Separated transit interchange concept
- Multimodal connection hub



Development Division

LYNNWOOD STATION SITE PLAN

Drop-off / Pickup Locations

Last-mile connection may be provided by shared mobility or automated vehicles

Aviation Division

Autonomous Aviation

- Unmanned Aircraft Systems, more commonly known as drones, arguably may be the lead industry in developing and implementing autonomous transport and travel.
- WSDOT Aviation Division is actively involved with the Washington state UAS community and industry.
- FAA regulatory oversight, until recently has, prohibited autonomous flight although many in industry claim the technology has been available for a number of years.
- The Amazon *Prime Air* program will rely on autonomous flight; with hundreds if not thousands of aircraft in the air, remotely piloted flight is insufficient to meet the anticipated demand; UAS companies will transition from remotely piloted drones to computer driven navigation and flight.
- Urban Air Mobility, an emerging industry segment in its infancy, will provide autonomous vertical take-off and landing (VTOL) passenger transport.

DJI Phantom UAS

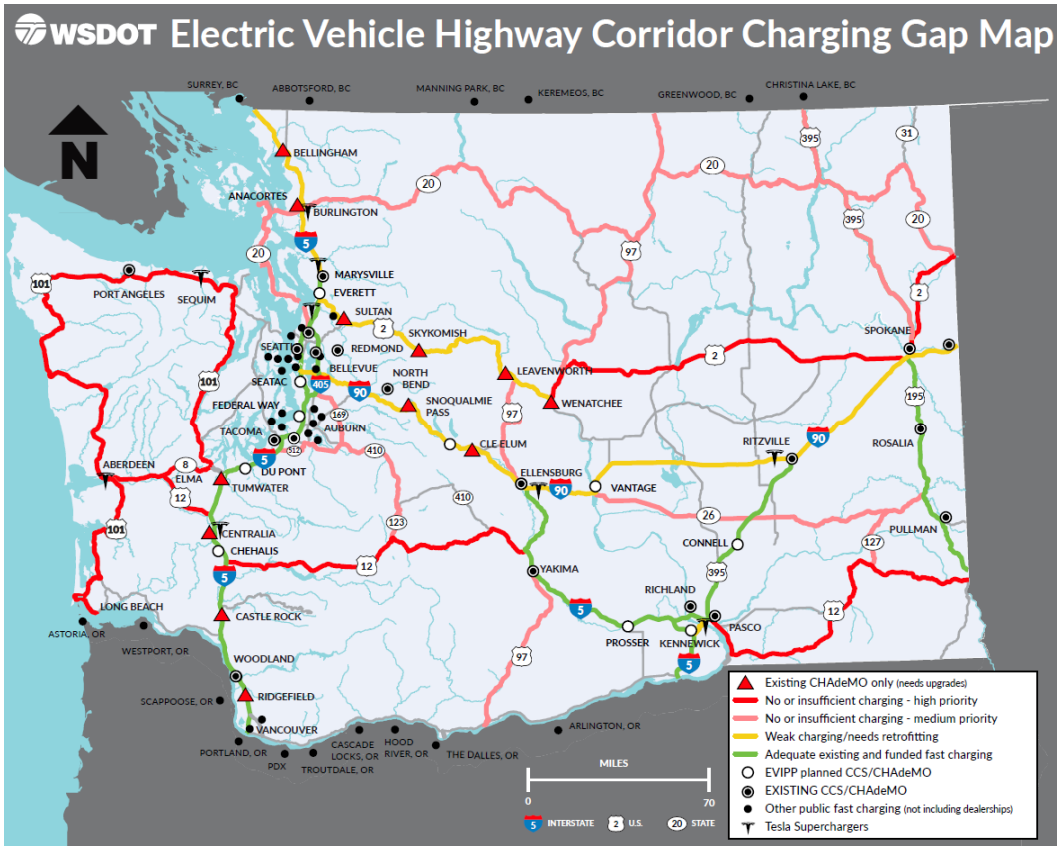
Amazon *Prime Air* Aircraft

Ehang Prototype rotor-wing eVTOL Aircraft

Uber Prototype fixed-wing eVTOL Aircraft

Innovative Partnerships Division

- Uses a portion of the annual electric vehicle registration fee to provide matching grants
- $1 million in state funding used to encourage private sector investment for 15 new locations totaling $2.5 million
- $100M would complete the gap map with charging station(s) every 70 miles



Immediate Priorities

- WSDOT: Pursing additional resources
  - Establish a WSDOT CAT Program ~$5 million / biennium
  - CAT Grant Program ~ $10 million / biennium
- AASHTO CAT Policy, Legislative and Regulatory Work Group
  - Identify and share CAT policy framework examples
  - Identify enabling funding mechanisms
  - Enable near-term deployments
- Washington State Transportation Commission, Autonomous Vehicle Work Group: Infrastructure and systems subcommittee
  - October 2, 2018 kickoff meeting

Engagement Opportunities

FLORIDA AUTOMATED VEHICLES

PENNSYLVANIA AUTOMATED VEHICLE SUMMIT 2018

NATIONAL DIALOGUE ON HIGHWAY AUTOMATION

ITS washington
intelligent transportation society of washington

TPF TRANSPORTATION POOLED FUND PROGRAM

TRB ANNUAL MEETING January 13–17, 2019 › Washington, D.C.

ACES NORTHWEST NETWORK
automated | connected | electric | shared

25TH ITS WORLD CONGRESS COPENHAGEN
17 – 21 SEPTEMBER 2018
Quality of life

AUTOMATED VEHICLES SYMPOSIUM 2018
USERS. VEHICLES. INFRASTRUCTURE.

NCoE

INNOVATIONS and PARTNERSHIPS in TRANSPORTATION
THINKING BOLDLY TO MOVE FORWARD TOGETHER

ITS AMERICA

The National Academies of SCIENCES · ENGINEERING · MEDICINE
TRB TRANSPORTATION RESEARCH BOARD

National Academies/TRB Forum
PREPARING FOR AUTOMATED VEHICLES AND SHARED MOBILITY
-KICK-OFF MEETING-

Governor's Autonomous Vehicle Work Group

Washington State Transportation Commission

Washington State Autonomous Vehicle Work Group

AASHTO CATCoalition

Policy, Legislative, and Regulatory Workgroup

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• Aviation Division	Robert Hodgman
• Communications	Ann Briggs & Barbara LaBoe
• Development Division	Jim Mahugh
• Innovative Partnerships Division	Anthony Buckley & Tonia Buell
• Local Programs	Kathleen Davis
• Maintenance Division	Chris Case & Joe Schmit
• Multimodal Planning Division	Kyle Miller
• Public Transportation Division	Gabe Philips & Ian Wesley
• Rail, Freight, and Ports Division	Jason Beloso & Matthew Pahs
• Research Office	Rhonda Brooks, Jon Peterson & Doreen Massjo
• Tolling Division	Robert Kopelk
• Traffic Operations Division	Lisa Ballard, Matt Neeley, Morgan Balogh & Michele Villnave

Questions

We welcome your input