Innovation in Action
Cooperative Automated Transportation (CAT)

WSDOT’s efforts to prepare for connected and automated vehicles

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Washington State Department of Transportation
Webinar, September 12th, 2018, 10:30-11:30 a.m.
Do our old standards meet today’s demands?

The 20th century way

How many people can this street serve per hour?
Up to 29,600

Source: Cal Trans' Street Design Guide
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?

**Connected Vehicle**
Communicates with nearby vehicles and infrastructure; Not automated

**Connected Automated Vehicle**
Leverages autonomous automated and connected vehicles

**Autonomous Vehicle**
Operates in isolation from other vehicles using internal sensors
What is a Connected Automated Vehicle?

SAE: Society of Automotive Engineers

<table>
<thead>
<tr>
<th>Level</th>
<th>Description</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No Automation</td>
<td>1967 Chevelle</td>
</tr>
<tr>
<td>1</td>
<td>Driver Assistance</td>
<td>1993 Accord</td>
</tr>
<tr>
<td>2</td>
<td>Partial Automation</td>
<td>Tesla Autopilot</td>
</tr>
<tr>
<td>3</td>
<td>Conditional Automation</td>
<td>Uber self-driving car</td>
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<tr>
<td>4</td>
<td>High Automation</td>
<td>Waymo Geofenced Shuttle</td>
</tr>
<tr>
<td>5</td>
<td>Full Automation</td>
<td>Waymo off-road Shuttle</td>
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</tbody>
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No Automation: Zero autonomy; the driver performs all driving tasks.
Driver Assistance: Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.
Partial Automation: Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.
Conditional Automation: Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.
High Automation: The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.
Full Automation: The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.
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.
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

AASHTO CAT
Coalition
Policy, Legislative,
and Regulatory
Workgroup

CAT Workgroup

WSDOT

Traffic Operations
Research
Aviation
Project Development
Multimodal Planning
Public Transportation
Freight
Tolling
Innovative Partnerships
Maintenance
Active Transportation

CAT Workgroup

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ITS America
WSDOT Organizational Efforts

Governor’s Autonomous Vehicle Work Group

AASHTO CAT Coalition Policy Legislative and Regulatory Workgroup Chair

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

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

March 22, 2018 SHB 2970
Transportation Commission facilitated AV Work Group
Washington State Transportation Commission Autonomous Vehicle Workgroup

- 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

Subcommittees

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

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

- Roadway infrastructure
- Traffic management
- Transit service & vehicles
- Advertising
- Right of way
- Multi-modal transportation
- Mobility as a service
On-road testing and deployment in Washington

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
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.
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 statute 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 WSDOT’s 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
Active Transportation Division

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

Pedestrian and Bicyclist Fatalities 2013-2017

- Pedestrian
  - 2013: 50
  - 2014: 77
  - 2015: 86
  - 2016: 88
  - 2017: 109

- Bicyclist
  - 2013: 10
  - 2014: 7
  - 2015: 14
  - 2016: 17
  - 2017: 13
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
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

AASHTO Signal Phase and Timing (SPaT) Challenge
- 4 locations across WA
  - 23 intersections

Communicate via centralized system

DSRC: Dedicated short range communications the vehicle to the traffic signal
Traffic Operations Division

I-5 Active Traffic Management Connected Vehicle Demo
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

   • What locations would benefit from CV equipment first and how should we adjust traffic signal timing?
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.
Preparing for Transit Connectivity

- Separated transit interchange concept
- Multimodal connection hub

We are considering shared mobility and autonomous vehicle drop-off/pickup locations in future projects.
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.
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

Governor's Autonomous Vehicle Work Group
AASHTO CATCoalition
Policy, Legislative, and Regulatory Workgroup
WSDOT CAT Workgroup Members and Contributors

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- 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