CAV and their Impact on Cities

Presenter
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Agenda

1. Vehicle Technology Redefined
2. Today
3. Tomorrow’s Next Steps and Impact on Cities
Vehicle Technology Redefined
Why use Connected **Automated** Vehicle (CAV)?

- “Autonomous” implies “acting independently.”
- “Autonomous” is still used widely in the media and automotive industry
- Many safety applications require connectivity
- USDOT now uses CAV (e.g. Proving Grounds 9/20/16)
- “Driverless” shuttles like EasyMile are SAVs
- “Automated” better describes the technology!
The Evolution of Connected and Automated Vehicles

**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

www.its.dot.gov

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On September 20, 2016, the U.S. DOT issued a policy for the safe testing and deployment of automated vehicles.
CAV is a Mobility Paradigm Shift
Resiliency = Robust Automated Mobility

**Sustainability** = Less, smaller & safer cars  
**Affordability** = Less capital construction  
**Equality** = Accessibility to everyone  
**Accommodating** = Provide flexible capacity  
**Influencing** = Enhances transit  
**Disruptive** = Employment

**Broad Access to Mobility Services**  
Seniors / Paratransit / Low Income Users/Job Search
Connectivity in motion

Vehicle to Infrastructure (V2I)
Connectivity in motion

Vehicle to Vehicle (V2V)
Connectivity in motion

Vehicle to Pedestrian (or Phone) (V2P)
Connectivity in motion

Vehicle to Cloud (V2X)

Photo Source: TechRepublic
NHTSA Notice of Proposed Rulemaking on Vehicle to Vehicle Communication, January 12, 2017
Shared Automated Vehicles
Basic Elements of a Shared Connected Automated Vehicle

- Localization uses LIDAR Laser Technology for both mapping and object recognition.
- Mobile App Driven
- Braking Systems: Regenerating, Hydraulic, Failsafe braking, and Electric Caliper
- Electric Power Train No Driver Controls
- GPS & LIDAR Mapping
- 5.9 GHz DSRC, Bluetooth, 4G, LTE, RTK
- Collision Avoidance is achieved through Lidar and video image processing
- Shared Automated Vehicle 12 Passenger Electric
CAV technologies impact how cities will:

- Operate
- Accommodate Growth
- Manage Congestion
- Improve the Economy
- Increase Safety
- Save Time
- Encourage Health
- Improve Quality of Life
How Do We Gain Confidence?

- Testbeds
- Pilot Projects
- Well planned and orchestrated
- Build on successes
- Societal Skepticism to Acceptance
USDOT CAV Proving Grounds

1. City of Pittsburgh and the Thomas D. Larson Pennsylvania Transportation Institute
2. Texas AV Proving Grounds Partnership
3. U.S. Army Aberdeen Test Center
4. American Center for Mobility at Willow Run
5. Contra Costa Transportation Authority & GoMentum Station
6. San Diego Association of Governments
7. Iowa City Area Development Group
8. University of Wisconsin-Madison
9. Central Florida Automated Vehicle Partners
10. North Carolina Turnpike Authority
Other CAV Proving Grounds

1. Transportation Research Center, Columbus, OH
2. Mcity, University of Michigan, Ann Arbor, MI
3. City of Tampa Pilot Project, Tampa, FL
4. I-80 Pilot Project, Wyoming
5. NYC CV Pilot Project, New York City
6. Active Arura, Edmonton, AB
GoMentum Station
Concord, CA

#1
Largest secure testbed in the US

5,000+ acres
with 2,100 acres available for testing

20+ miles
of paved roadways with a 7-mile long spine road for high speed testing

1 of 10
USDOT Designated AV Proving Grounds
A Platform for Transforming the Future

What is GoMentum Station?

Redefining Mobility

...while addressing the real congestion/safety need
Key AV Partners

Testing at GoMentum Station
Test Objective: Traverse Suburban Residential Streets
Test Objective: Passenger Feedback

Test Objective: Navigation and Interface App
Test Objective: At Grade RR Crossing
Test Objective: Parking
“Transit Accessibility” will be the key

First Mile/Last Mile Solution
Largest CV Testbed in Canada
3 Corridors
Rural Freeway
Urban Expressway
Urban Arterial
3 Testing Stages
Improving Safety
Driver Behavior
Congestion Reduction

ACTIVE-AURORA
Edmonton, AB

#1
Largest CV Testbed in Canada

3 Corridors
Rural Freeway
Urban Expressway
Urban Arterial

3 Testing Stages
Improving Safety
Driver Behavior
Congestion Reduction

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ACTIVE AURORA

Testing CV systems, technologies, applications and services for traffic, transit, goods movement, and active transportation.
ACTIVE-AURORA Test Bed Network

- $3.6 million test bed for connected vehicles
- Testing both DSRC and mobile cellular environments
- Stantec’s role: Project Manager and Designer
- Over 60 RSUs in multiple corridors
- 5.9 GHz developmental license
Connected Vehicles

Direct Short Range Communications Environment
Connected Vehicles

Stantec Design of Electrical Systems
CAV Testing
Lessons Learned
Lessons Learned by Stantec

Issue

Default Deceleration
• Highly automated vehicles disengage/decelerate as a default in most challenges.
  • How do they perform compared to a human driver?
  • Will we see in an increase in delay?

Technical Redundancy
• Multiple LIDAR, Sensors, Data Management
Lessons Learned by Stantec

Recommendation

Resilience
• The ability of a highly-automated vehicle to identify, respond to, and recover from a safety challenge.

Need Oppositional Testing
• Instead of collaboration to pass tests, the track owners attempt to defeat the highly-automated vehicle into a crash or unsuccessful result by introducing increasingly difficult safety challenges.
Resilience Engineering in CAV Testing

- Safe Operation
- Response to a Challenge
- Recovery
Field of Play In Tennessee

Automated Vehicle Legislation/Law

States with Enacted Autonomous Vehicle Legislation

LEGEND
Enacted
Executive Order

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2015 Automated Vehicle Legislation/Law

Legislation was passed that added a automated vehicle section to the Tennessee Code (TCA § 55-8-202). This section included a basic definition of AV Technology, and added a provision that outlawed any political subdivision from prohibiting the operation of vehicles equipped with AV technologies.
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2016 Automated Vehicle Legislation/Law

Legislation was passed that added additional definitions to the Tennessee Code AV Section (TCA § 55-8-202). Additions included a refined definition of automated technology, which includes the dynamic driving tasks, and driving modes.
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2017 Automated Vehicle Legislation/Law

SB151/HB381

- Adds a section that addresses the certificate of registration for vehicles with automated systems.
- Addresses the definition of a “Driver”, “Operator”, and “Person” to be inclusive to automated systems.
- Adds a definition for a “Automated-Driving-System-Operated Vehicle, or “ADS-operated vehicle”.
- Adds a definition for a “minimal risk condition” and the “dynamic driving task”.

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2017 Automated Vehicle Legislation/Law

SB151/HB381 (cont.)

- Addresses child and passenger restraint law by resolving the automated systems or the owner.
- Addresses accident reporting requirements.
- Establishes that a automated vehicle, defined in the law as ADS-operated, can drive or operate on streets and highways in the state without a human driver physically present in the vehicle, if 4 conditions are met.
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2017 Automated Vehicle Legislation/Law

SB151/HB381 (cont.)

4 Conditions of ADS-Operated Vehicle operating without a driver physically present:

1. The vehicle is capable of being operated in compliance with state law, and certified by the manufacturer as being in compliance with federal motor vehicle safety standards.

2. The vehicle is capable of reaching a “minimal risk condition” in the event of failure of the automated systems.

3. The vehicle is registered in the state and identified as an ADS-operated vehicle.

4. Is covered by primary automobile liability insurance of up to $5,000,000 per incident.
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2017 Automated Vehicle Legislation/Law

SB676
This bill resolved the truck following distance limitations in law for platooning vehicles, and established a notification process for operations in Tennessee that includes the Department of Safety and Transportation.
Questions?