Testing the Unexpected: Autonomous Vehicles
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Testing the Unexpected: Autonomous Vehicles
What is AAMVA doing to help our members prepare for Automated, Autonomous and Connected vehicles?
• December 2013 - Established an Autonomous Vehicle Information Sharing Group.

• Group has held conference calls monthly to review state laws, studies, news articles and hear from experts.

• Developed an AV Information Library on AAMVA’s website to store information on AVs.
AV Information Sharing Working Group

- Developed an analysis of current AV state laws.
- Identified the program areas such as operator training, testing and licensing, vehicle registration and title, data privacy and security concerns, consumer safety and other areas of concern to the DMVs and Law Enforcement that will be impacted by AVs.
- Provided information to larger AAMVA community during meetings and conferences.
- 2015 - Continuing to hold quarterly calls.
AV Best Practices Working Group

Fall 2014 - Established an Autonomous Vehicle Best Practices Working Group

The purpose of the project is to form a Best Practices Working Group to:

• Work with the AAMVA jurisdictions, law enforcement, federal agencies and other stakeholders to gather, organize and share information with the AAMVA community related to the development, design, testing, use and regulation of autonomous vehicles and other emerging vehicle technology.

• Based on the group’s research, a best practices guide to assist member jurisdictions in regulating autonomous vehicles and testing the drivers who operate them will be developed.

• Funded by NHTSA
Objectives and Timeline

The Working Group will:

• Research and gain an understanding of autonomous vehicles and other emerging vehicle technology, the impact they will have on the AAMVA membership, and define the potential regulatory concerns the technology will create.

• Develop and draft Best Practices. 2015 -2016

• Provide the draft best practices to the AAMVA Driver, Vehicle, and Law Enforcement Committees and to NHTSA for review and comment. Late summer 2016

• Review all comments and suggestions and modify the draft as appropriate. Late summer 2016

• Release and promote the final Best Practices document to AAMVA jurisdictional members and stakeholders. Fall 2016
Working Group

The Working Group will consist of:

• 16 jurisdictional members; including representatives with vehicles, driver license, law enforcement, information technology and legal expertise.

• 2 Canadian jurisdictional representatives to be funded by CCMTA

• 3 positions held by NHTSA representatives.

• 4 AAMVA staff plus the project officer.

• A consultant.

• Stakeholders to act as advisors.
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Setting the stage for discussion ...

Autonomous Vehicles
Technology-Driven Mobility

March 19, 2015

Al Biehler
Executive Director
T-SET University Transportation Center
Carnegie Mellon University
Connected Vehicles

Dedicated Short Range Communication (DSRC)
Autonomous Vehicles
Autonomous Vehicle Sensing

DARPA Challenge 2007  (Defense Advanced Research Projects Agency)
Connected and Autonomous Vehicles

Connectivity

- Includes all types of communication with vehicles and infrastructure (Wi-Fi, DSRC, Cellular, etc.)

**Autonomous Vehicle**

Operates in isolation from other vehicles using internal sensors

**Connected Vehicle**

Communicates with nearby vehicles and infrastructure

**Connected Automated Vehicle**

Communicates with nearby vehicles and infrastructure
Carnegie Mellon University
30 Years of Self-Driving Car Research

1984
- The Terregator’s top speed was a few centimeters per second; it could avoid obstacles.
- NavLab launched. Its goal: apply computer vision, sensors and high-speed processors to create vehicles that drive themselves.

1986
Humans or computers controlled NavLab1, a Chevy van. Top speed: 20 mph.

1990
NavLab 2, a US Army HMMWV, wrangled rough terrain at 6 mph. Highway speed: 70 mph.

1995
NavLab 5, a Pontiac Trans Sport, traveled from Pittsburgh to San Diego in the “No Hands Across America Tour.”

2000
- NavLab 11, a Jeep, was equipped with Virtual Valet.

2005
- Sandstorm and Highlander placed 2nd and 3rd in the DARPA Grand Challenge.

2007
- Carnegie Mellon’s “Boss” won the DARPA Grand Urban Challenge by outmaneuvering other vehicles along the 55-mile course.

2014
- Carnegie Mellon’s 14th self-driving vehicle is a Cadillac SRX that:
  - avoids pedestrians and cyclists
  - takes ramps and merges
  - recognizes and obeys traffic lights
  - looks like other Cadillac SRXs

www.engineering.cmu.edu

Carnegie Mellon University
General Motors - Carnegie Mellon
Autonomous Driving Collaborative Research Lab
Pittsburgh Demonstration
September 2013

33 miles along US 19 in multi-lane, dense traffic with lights and two interstate highways

Cranberry Township

Pittsburgh Airport

Carnegie Mellon University
Washington Demonstration

June 2014

21 Signalized Intersections
ROAD TO AUTOMATED DRIVING

Today's Driver Assist Package

"SuperCruise" Concept

Emergency Intervention (Limited Control)

Limited On-Demand Automation (Monitored Control)

Complex On-Demand Automation (Transferred Control)

Autonomous Driving (Chauffeured Driving)

TECHNOLOGY ENABLERS:
Perception & Algorithms
Integrated Sensing with Maps, GPS, V2X
Driver State Knowledge

Today

Future

Increasing Capability
Technology available right now

Mercedes S500

- **Distronic Plus w/ Steering Assist**
  - Stay in lane
  - Brake
  - Accelerate
- **Active lane assist**
- **Active blind spot assist** – active breaking, warning
- **Attention assist** - takes into account 75 factors to determine if driver is getting drowsy – beep alert with message
- **Night view assist** – infrared cameras identify animals, pedestrians – automatically flash headlights
- **Active parking assist** – scans row of cars for spot of sufficient width and automatically parks the car
“....driverless cars will be fully operational in the next six years...”

...the need to perfect "machine vision" and advancements in sensor technology are the only obstacles to seeing the cars fully operational”

*Elon Musk, Wall St Journal, 9-18-14*
Mercedes-Benz Future Truck 2025

Autobahn Demonstration July 4, 2014
“If the legislative framework for autonomous driving can be created quickly, the launch of the Highway Pilot is conceivable by the middle of the next decade.”

Wolfgang Bernhard
CEO, Daimler Trucks
Autonomous Vehicle Legislation

Current Status
- Passed
- Under Consideration
- Failed
Connected and Autonomous Vehicles
2040 Vision

Barry Schoch
Secretary
Infrastructure investment and design

- Evaluate planned capacity enhancements
- Reconfigure and repurpose lanes.
- Dedicate highway lanes to autonomous vehicle use.
Communication devices / real time data use

- Collaborate with private sector to convert data into information.
- Begin deployment of V2I applications at key locations.
- Deploy equipment and applications on a large scale.
Driver licensing

• Design driver license training for emergency situations.

• Provide for a new license class for those wishing to drive their cars manually.
Workforce training needs

• Continually revamp workforce training
Freight movement

- Work with the trucking industry and State Police to design safety and enforcement features.
Policy Implications of Connected Automated Vehicles
Policy Implications

Connected and Autonomous Vehicles

- Safety
- Mobility & Access
- Congestion & VMT
- Public Transportation
- Energy & Environment
- Land Use
- Economy & Jobs
- Drastic reduction in crashes / fatalities
- Regulation vs free entry
- Liability shift

<table>
<thead>
<tr>
<th>2011</th>
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<td>2.2 million Injuries</td>
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<td>32,000 fatalities</td>
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- Populations with new freedom
- Lifestyle, job and education opportunities
- Societal and economic impacts

Current non-drivers, constrained drivers.
Congestion & VMT

Change recent VMT trends?
Urban, suburban, rural differences?
Absorb increases with more efficient operation?
Travel forecasting

Public Transportation

Undermine?
Advantages?
Tipping point factors / application?

Paratransit constitutes 14-18% of transit budgets

U.S. congestion costs $120 billion annually.
Energy & Environment

- Impact on energy consumption and air emissions
- How optimize?
- Impact on use of alternate fuel vehicles

Land Use

- Home, commercial and retail location
- Form
- Zoning requirements
- Incentivize investment choices

Connected pod-car automated vehicles could reach over 300 mpg.

Reduced CBD parking / driverless taxis.
Economy & Jobs

- Impacts to manufacturing and service economies
- Crash industry — *Insurance companies, attorneys, courts, body shops, parts manufacturers*
- Displacement of good wage driving jobs
- State and local revenue
  - *Parking, licensing, fuel taxes, moving violations*
Disruptive Technology
Connected & autonomous driving will be a reality
Stay involved to capture the benefits & avoid consequences
Autonomous Vehicles in California

Brian G. Soublet
Deputy Director and Chief Counsel
California DMV
California at a glance

- Approximately 38 million people
- Over 25 million driver licenses and identification cards
- Over 32 million actively registered vehicles
- Over 73% commute to work alone
- Over 172 thousand public road miles
- Over 323 billion vehicle miles travelled per year
- Variety of terrain and weather conditions
California Legislation – Senate Bill 1298

As soon as practicable, but no later than Jan. 1, 2015, DMV must adopt regulations setting forth requirements for:

- Manufacturers’ *testing* of autonomous vehicles on public roadways
- *Operation* of autonomous vehicles on public roadways
NHTSA defines 4 levels of autonomous vehicles

- Level 0 – No automation
- Level 1 – Function specific automation
- Level 2 – Combined function automation
- Level 3 – Limited self-driving automation
- Level 4 – Full self-driving automation

Society of Automotive Engineers (SAE) has similar definitions, although 5 levels
“Autonomous Vehicle” does not include:

- Vehicles equipped with one or more driver assistance systems that enhance safety but are not capable, singularly, or collectively, of driving the vehicle without the active control or monitoring of a human.

- Blind spot + adaptive cruise control + lane keep + traffic jam assist + emergency braking - NOT autonomous.
Regulatory Package 1: Manufacturers’ Testing

- Two pre-notice workshops
- 45-day public comment period
- Formal public hearing
- 15-day public comment period
- Regulations approved and adopted in May 2014
- Effective on September 16, 2014
Testing Regulations Summary

- $5 million in insurance, bond, or self-insurance
- Test drivers: no DUI, not an at-fault driver, and no more than 1 point
- Successful completion of test driver training program
- Employee, contractor, or designee
- Seated in driver seat during testing
- Report any accident within 10 days
- Report unanticipated disengagement of autonomous technology
- Testing permit valid for one year
- Vehicles excluded from testing:
  - Commercial vehicles
  - > 10,000 lbs GVW
  - Motorcycles
Approved Testing Permits

- Volkswagen/Audi
- Mercedes
- Google
- Delphi Automotive
- Tesla Motors
- Bosch
- Nissan
Regulatory Package 2: Operation on California Public Roadways

- Contract with UC Berkeley for recommendations
- Two pre-notice workshops have been held
- 45-day public comment period once regulations are in final form
- Formal public hearing

**Overriding issues:**

- Certifications that are required by statute.
  - Traditional self-certification vs. 3rd party certification
  - Creating standards for certification
- Operational and deployment restrictions
- Cybersecurity
- Avoidance of Preemption
Operational Regulations Summary (Draft)

- Specify if vehicle is capable of operating without a driver inside
- Disclose the designed areas of operation
- Sensor data recorded 30 sec prior to collision
- Disclosure to occupants that data not necessary for safe operation of vehicle is being collected
- $5 million in bond, or self-insurance
- NHTSA Level 4 vehicles issued distinct special license plate
- No special driver license requirement
- Other requirements are currently being vetted
Questions

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Ontario Ministry of Transportation

Automated Vehicles:

Ontario’s Approach to Date
Overview

• Need for Action
• Legal Framework
• Ontario’s Approach to Date
• Challenges
• Next Steps
Need for Action

• MTO has been approached by some domestic automotive technology stakeholders to consider facilitating the on-road testing of fully automated vehicles in Ontario.

• Many automotive and software companies such as Toyota, Google, QNX, Nissan, Audi, Mercedes-Benz, Ford, Volkswagen, Volvo, General Motors, Lexus, BMW, Cadillac and Continental have developed autonomous prototypes and/or have begun testing driverless car systems.
Ontario’s Legal Framework

• Road Safety is governed by a number of statutes in Ontario, the most common being the Highway Traffic Act, or HTA

• The HTA does give us authority to regulate vehicle equipment and the type of vehicles permitted on road

• Also allows us to create regulations to test new technology in a controlled way
Role of Canadian Federal Government

• Generally, we look to the Federal government to determine matters of vehicle safety for the purposes of import and sale – i.e. safety equipment and standards such as seatbelts, air bags, etc.

• While provinces do have some autonomy when it comes to regulating what vehicles will be permitted on road we do look to our Federal government to provide a consistent, national standard on matters that impact more than one jurisdiction.
Ontario’s Approach to Date

Adopting a three-step process:

1) Stakeholder Consultations

2) Development of testing regulation

3) Implementation and Evaluation
Stakeholder Consultations

• Online Regulatory Registry posting for 45 days.

• Face-to-face stakeholder consultations last Spring and Fall, and ongoing, with representation from insurance, auto manufacturing and technology industries, enforcement, Insurance and Transport Canada.

• Member of various AAMVA and Canadian Council of Motor Transport Administrators (CCMTA) working groups
Regulation Development

- HTA Section 228 provides the authority to implement pilot projects, of up to 12 years, by regulation to test and evaluate new vehicles on Ontario’s public roads.
  - Segways
  - Electric Low-Speed Vehicles

- As we go through this process, in addition to weighing the needs of stakeholders, we are also mindful of other policy considerations such as:
  - Road safety
  - Definition
  - Licensing/registration
  - Insurance requirements
  - Owner/operator responsibility/liability
  - Vehicle standards
Challenges:
What would be regulated?

2 Broad Categories of Vehicle

• OEM Vehicles
  - Cars we see today with autonomous features
  - The “google car” – no pedals, no steering wheel, no driver envisioned

• “Retrofit” Vehicle
  - Existing vehicles, with few or no automated features, being equipped to operate autonomously
Challenges: Innovation vs Regulation

- Balance between Road Safety and Innovation in the auto sector.

- Regulatory consistency/harmonization
  - Ontario setting out on their own may create an inconsistent regulatory regime within Canada and with neighbouring U.S states
Challenges: Data Collection

• The more data the better…

• In order to evaluate the safety of autonomous technology any regulatory regime should include data collection and evaluation.

• But what data is the right data to collect?
  • Collision involvement?
  • Unexpected system failures?
  • “Near misses”?
  • Black box and censor data?
  • Km driven?
Next Steps

• Complete development of policy options and seek Government approval

• Continue to engage stakeholders

• Launch, collect data, and evaluate the potential pilot program
  • What does the data tell us?
  • Is our existing regulatory framework suitable for automated technology or are legislative and regulatory changes needed to better regulate the use of the technology as it becomes more available?
QUESTIONS?

EXPERIENCES TO SHARE FROM YOUR JURISDICTIONS?
Testing the Unexpected: Autonomous Vehicles