California Legislature

SENATE COMMITTEE ON TRANSPORTATION AND HOUSING

JIM BEALL
CHAIRMAN

STATE CAPITOL, ROOM 2209
SACRAMENTO, CA 95814
TEL (916) 651-4121

INFORMATIONAL HEARING
SENATE TRANSPORTATION AND HOUSING COMMITTEE

Autonomous Vehicles: Opportunities and Challenges

Tuesday, February 20, 2018
10:00a.m. — John L. Burton Hearing Room (4203)

AGENDA

I. Opening Remarks

- Senator Jim Beall, *Chair,* Senate Transportation and Housing Committee

II. PANEL 1 – Public Interest Perspective

- California Department of Motor Vehicles -- Jean Shiomoto, Director
- University of California Davis; Institute for Transportation Studies -- Dan Sperling, Director
- Los Angeles Department of Transportation -- Seleta Reynolds, General Manager
- City of San Jose -- Jill North, Innovation Program Manager
- Livermore Amador Valley Transit Authority -- Michael Tree, Executive Director

III. PANEL 2 -- Stakeholder Perspectives

- Consumers for Auto Reliability and Safety -- Rosemary Shahan, President
- General Motors -- Harry Lightsey, Executive Director, Emerging Technologies Policy
- Lyft -- Laura Bisesto, Public Policy Manager
- Waymo -- Ron Medford, Director of Safety
- Teamsters Joint Council 7 -- Doug Bloch, Political Director

IV. Public Comment

V. Closing Remarks

California Legislature

SENATE COMMITTEE ON TRANSPORTATION AND HOUSING

JIM BEALL
CHAIRMAN

STATE CAPITOL, ROOM 2209
SACRAMENTO, CA 95814
TEL (916) 651-4121

INFORMATIONAL HEARING
SENATE TRANSPORTATION AND HOUSING COMMITTEE

Autonomous Vehicles: Opportunities and Challenges

Tuesday, February 20, 2018
10:00a.m. — John L. Burton Hearing Room (4203)

BACKGROUND PAPER

Introduction

Autonomous vehicle (AV) technology is rapidly developing and will fundamentally change the world of transportation. Autonomous (also called self-driving, driverless or robot) vehicles promise many economic and societal benefits, such as reductions in crashes, energy consumption, vehicle emissions, and traffic congestion as well as increased mobility. However, this promise may not be realized without conscious policy choices, which must be informed by the recognition of the potential risks of this technology.

There is often a trade-off between encouraging innovation and advancing our societal values. Finding the right balance will require a better understanding of the opportunities and risks associated with AV technology.

Background

What are "autonomous" vehicles?

The Society for Automotive Engineers International (SAE) has developed a framework to define increasing levels of driving automation:

- Level 0: The human driver does all of the driving.
- Level 1: Automated system on the vehicle can assist the human driver with *one* part of driving (*e.g.*, automatic brakes).
- Level 2: Automated system can handle *both* steering and braking/accelerating in some circumstances (*e.g.*, adaptive cruise control), but the driver must be engaged at all times and do the rest of the driving.
- Level 3: Automated system can do *all* of the driving, in some circumstances. However, the driver must be able to take control when prompted by the system.
- Level 4: Automated system can do all of the driving, in some circumstances. The driver or passenger does not need to pay attention.
- Level 5: Automated system can do all of the driving under *all* circumstances.

Most vehicles on the market today have some automated technology (Levels 1-2) to assist drivers, such as automatic brakes, adaptive cruise control, and traffic jam assist[1]. The California Department of Motor Vehicles (DMV) defines autonomous vehicles as vehicles with automated technology of Levels 3-5, because the vehicles do not require the active monitoring by a human driver and thus are regulated separately.

Federal Regulations

In 2017, the U.S. Department of Transportation (DOT) and the National Highway Traffic Safety Administration (NHTSA) released a report called *Automated Driving Systems: A Vision for Safety 2.0*,[2] which provides voluntary safety guidance for manufacturers developing AVs and best practices for state legislatures to regulate AVs. DOT advises states "to allow DOT alone to regulate the safety design and performance aspects of AV technology," and instead to focus on developing the licensing, registration, and insurance procedures for AVs.

In Congress, the House passed the SELF-DRIVE Act in August 2017 with bipartisan support. This bill would pre-empt states from banning autonomous vehicles and allow car manufacturers to get an exemption from the Federal Motor Vehicle Safety Standards for up to 100,000 autonomous vehicles. The Senate has its own version of an AV bill, but that bill is moving much more slowly. Administratively, the DOT has announced a March 1, 2018 stakeholder meeting to "identify priority federal and non-federal activities that can accelerate the safe rollout" of AVs.

Some are concerned that without a federal regulatory framework, states are creating a patchwork of different AV regulations across the country. Twenty-one states, including California, have passed legislation and five states have issued executive orders related to regulating the testing and deployment of autonomous vehicles.

---

[1] A form of adaptive cruise control, where automated system can take over steering and accelerating/braking, in slow traffic.

[2] https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/13069a-ads2.0_090617_v9a_tag.pdf

California Regulations

In 2012, the Legislature passed SB 1298 (Padilla), which established conditions for the testing and deployment of AVs on California roadways.[3] In 2014, the DMV adopted regulations to create a permit for manufacturers to test AVs (with a backup safety driver) on California public roads.[4] As of today, 50 manufacturers have been permitted.[5] In this program, manufacturers are required to maintain $5 million in insurance coverage, report any accidents to the DMV within 10 days, and annually report the number and circumstance of any disengagement of the autonomous system (i.e., an event where the safety driver has to take control).

In January 2018, the DMV submitted a final regulatory package, to cover *driverless* testing and deployment of AVs, for approval to the Office of Administrative Law.[6] These regulations continue to prohibit the testing and deployment of AVs weighing over 10,000 pounds. The new regulations create a permit for testing AVs *without* a safety driver on California roads. Manufacturers applying for this permit must comply with a few additional requirements, such as providing written notification to local authorities and a law enforcement interaction plan to law enforcement agencies and other first responders in the testing vicinity.

The regulations also create an additional permit for manufacturers to deploy (sell, lease, provide transportation services for a fee, or make commercially available) AVs on public roads. To obtain and operate with this permit, a manufacturer must comply with a series of requirements: 1) maintain insurance on the vehicle; 2) provide DMV with the specific operational design domain (ODD) of the AV (*i.e.*, the road and environmental conditions in which the AV is designed to operate); 3) equip the vehicle with an autonomous technology data recorder that will capture all vehicle functions at least 30 seconds before a collision in a readable format; 4) comply with federal and state motor vehicle standards and safety guidelines on AVs; 5) meet current industry standards on defending against cyber-attacks; 6) provide a law-enforcement interaction plan; 7) provide a summary of the testing results; and 8) provide a written disclosure to the consumer that describes any personal information that will be collected, or anonymize that information.

AV Deployment Models

Under these regulations, there are a few likely models of deployment for AVs in California in the near future.

1) Personal AVs – Consumers buy or lease their own AVs. In this model, manufacturers develop the autonomous technology and the vehicle and sell or lease them directly to consumers for personal use. Tesla has announced plans to roll out a Level 4 autonomous system in their cars by 2019.

2) Autonomous rides – AVs transport individuals and groups through ride-hailing services. In this model, the manufacturer builds autonomous cars or installs their autonomous technology

[3]California was among the first states to enact a law authorizing AV testing and deployment. This bill was primarily supported by Google, which at the time was leading the then nascent AV industry.

[4] https://www.dmv.ca.gov/portal/dmv/detail/vr/autonomous/testing

[5] In 2017, Google's Waymo and GM's Cruise were the most prolific testers of AVs in California with 350,000 and 130,000 miles travelled respectively by their AVs.

[6]OAL approval is expected in February 2018.

onto existing cars and operates them as a fleet. This is the model that Waymo, Uber, Lyft, GM, and other Original Equipment Manufacturers have announced plans to do.

3) Small delivery vehicles – AVs are used for "last mile" deliveries of groceries, packages, etc. In this model, the manufacturer builds AVs and partners with major firms involved in delivery, such as store chains and Amazon.

Opportunities and Challenges of AV Deployment in California

Public Safety

One of the key potential benefits of AVs is increased driving safety. Auto accidents remain a leading cause of death with 3,700 fatalities caused by crashes in California in 2016. According to NHTSA, 94% of serious motor vehicle crashes are attributable to human error.[7] AVs have the potential to save lives and reduce injuries by removing humans from the driving equation.

However, there is a question of how safe AV technology currently is and how much safer it will need to be compared to humans, before they fully replace human drivers. The sensors and computers on AVs are able to see more of the driving environment and react faster than humans; however, the challenge for these automated systems is correctly *interpreting* a driving situation in real-time to make the appropriate decision. There are many complex and unpredictable situations encountered when driving on California's streets, such as construction, police-directed traffic, poor signage and road markings, and road obstructions, which may be difficult for an automated system to always navigate safely. Also, as vehicles are more computerized and connected, they will be more vulnerable to cyberattacks and viruses.

Public Acceptance

How will the public accept AVs? A recent study by AAA found that 63% of U.S. drivers are afraid to ride in a fully self-driving vehicle, a high number that is nevertheless down from 78% one year ago.[8] The interaction between AVs and humans, both drivers and pedestrians, must also be considered. AVs that strictly adhere to speed limits and stop for all pedestrians may enrage riders or other drivers who are accustomed to less fidelity to the letter of the law.

Economic Development

California, the home of many leading companies and manufacturers in this burgeoning industry, is positioned to be a global research and testing hub for AVs. However, other states are starting to take the lead on AV regulations (or lack thereof) to encourage the research and testing of AVs in their states. Notably, Arizona was the location of the first testing of a "driverless" autonomous passenger vehicle on US public roads (performed by Waymo in 2017[9]) and will be the location of the first launch of a commercial, autonomous, ride-hailing service with its driverless minivans in 2018.

---

[7] *NHTSA*. Automated Vehicles for Safety. https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety

[8] Millennial and male drivers are more comfortable with AVs, baby boomers and women less so; http://newsroom.aaa.com/2018/01/americans-willing-ride-fully-self-driving-cars/

[9] https://www.theverge.com/2017/11/7/16615290/waymo-self-driving-safety-driver-chandler-autonomous

Also, California prohibits testing and deployment of AVs over 10,000 pounds. Many other states, such as Arizona and Florida, are allowing for the testing of autonomous truck technology. Autonomous trucks could benefit the freight industry by improving the safety, efficiency and capacity of freight transport.

Employment

A primary concern with AV deployment is that it could make driving an obsolete occupation. This is an imminent issue for taxi and Transportation Network Companies (TNCs, *e.g.* Lyft and Uber) drivers, as ride-hailing fleets are likely to be the first wave of AV deployment. It is also a concern for truck drivers. According to one study, autonomous trucks may reduce the demand for truck-driving jobs by 50-70% by 2030.[10]

Yet some contend that it will be many years before AVs will reduce the number of TNC jobs.[11] Also, some posit that long-haul, autonomous trucks or platoons may require a driver on board to maintain and manage the trips (like airplane pilots). These jobs could improve the lot of truckers, since the travel time could be used for leisure, rest or other work.[12] Also, AVs, though they don't need drivers, may require 'remote' operators to manage them.

Congestion

Los Angeles and San Francisco are two of the five most congested cities in the world[13], which must come as no surprise to their residents. AVs have the potential to ease traffic congestion in a variety of ways. AVs can platoon (drive close to one another, precisely matching each other's speed), which will smooth traffic flow and increase throughput on roads and highways. AVs will also lower the cost of traffic, because vehicle occupants could use the travel time for work, leisure or sleep. And because AVs won't need nearby parking, streets could be redesigned with no parking spaces and thinner driving lanes, allowing for more sidewalks and bike lanes, and the land underneath parking structures can be reused for other, higher purposes.

However, it is also possible that people may choose to take more vehicle trips or longer vehicle trips, especially since the travel time could be used for other purposes. This could lead to increased congestion overall, especially if they are mostly single-rider trips rather than shared rides. Congestion may also increase from additional AVs without any riders (e.g., autonomous taxis waiting for riders, personal vehicles returning home after dropping off their owner, autonomous delivery trucks operating 24/7).

Energy Use and Emissions

AVs also promise to reduce vehicle emissions and energy use by improving travel efficiency. However, if AV deployment actually increases vehicle-miles travelled, then it could have the opposite effect, depending on how the AV is powered and the type of vehicle it replaces. Currently, some manufacturers (like GM's Cruise) have committed to a fully electric AV fleet, while others (Waymo) are based on hybrid vehicles. Another potential benefit of AV technology is that vehicles could be designed to be lighter, due to its greater safety, improving fuel

[10] International Transport Forum; May 31, 2017: https://www.itf-oecd.org/driverless-trucks-new-report-maps-out-global-action-driver-jobs-and-legal-issues

[11] http://www.businessinsider.com/travis-kalanick-interview-on-self-driving-cars-future-driver-jobs-2016-8

[12] http://www.ttnews.com/articles/how-autonomous-trucks-could-lead-more-driving-jobs-not-fewer

[13] INRIX Global Traffic Scorecard; February 5, 2018: http://inrix.com/press-releases/scorecard-2017/

efficiency. Lighter vehicles would also facilitate electrification and alternative fuel usage. However, some analyses have noted that AVs consume a lot of power, due to the sensors and computer processes, thus reducing fuel efficiency.[14]

Mobility

Many people do not drive, either by choice or because of age or ability. AVs promise mobility and independence for many of these non-drivers, an enormous improvement in their quality of life. But AV technology is not inexpensive. It would be a lost opportunity if AV technology only helped those who can afford it, rather than the broader public.

Public Transit

AVs may replace public transit usage. This may reduce support for public transit services overall, which will harm those who rely heavily on public transit and may not be able to afford AVs. However, AVs (and TNCs) have the potential to enhance public transit, by providing less costly and more convenient last-mile/first-mile services to and from traditional transit stops (e.g., micro transit).

Data and Privacy

In order to operate safely, AVs and their manufacturers are collecting massive amounts of data on California's public roads. Sharing this data (e.g. traffic flow, the presence of potholes or missing traffic signs) with local jurisdictions could help them improve their road infrastructure and transportation planning. The personal information of AV users, including trip information and travel patterns, is sensitive and may need disclosure requirements or protection.

Law Enforcement

AVs also need to be able to interact appropriately with law enforcement and emergency vehicles (e.g., pulling over to the side for fire trucks and ambulances) and vice versa. For example, in the case of a collision, law enforcement officials typically interact with the driver(s). In an AV collision, it isn't clear who the law enforcement official interacts with and how the vehicle can be moved to a safe place.

Conclusion

AV technology is coming quickly to California roads, and with it, a host of new opportunities and challenges. AVs promise to save lives, provide mobility, and reduce congestion. However, there is uncertainty about these benefits and there are also many potential costs, from job losses to reduced transit ridership. Policymakers will need more information to develop appropriate policies to achieve these benefits, while minimizing harmful consequences.

[14] https://www.wired.com/story/self-driving-cars-power-consumption-nvidia-chip/