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# **Issues in Development of Regulations for Automated Driving Systems: Lessons from the California Experience**

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# Overview

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- **Why so soon?**
- **Range of issues to consider**
- **Fundamental challenges**
- **Background on levels of automation**
- **California example:**
  - **Sequence of events**
  - **Legislative and administrative rules**
  - **Testing on public roads**
  - **Operation by the general public**
  - **Driverless operation**

# Why so soon?

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- **Google was concerned about lack of clear legal status for their automated vehicle testing**
  - **Google lobbied state legislatures for laws to cover testing and operation by general public**
  - **Original Google lobbyist language morphed from state to state and as their business model changed**
  - **NHTSA 5/30/13 preliminary policy statement said go slow and only authorize testing**
    - **Also defined (vaguely) 4 levels of automation**
    - **No additional state laws passed**
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# Issues to Consider

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- **Due diligence in protecting general public while unproven systems are being tested among them**
- **Trying to ensure that general public really understands limitations of their vehicles**
- **Detecting unsafe systems as early as possible (earlier than NHTSA?)**
- **Adapting or re-interpreting existing codes:**
  - **Responding to law enforcement officer commands**
  - **Exchanging insurance information after crashes**
  - **Restrictions on driver behaviors (DUI, open alcohol containers, cell phones, texting, distraction, recklessness...)**
  - **Protection of unattended children...**

# Fundamental Challenges

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- **Balancing need to protect public safety with desire to encourage technological innovation**
- **Automation blurs the traditional boundary between federal responsibility for regulating new vehicle equipment and state responsibility for regulating how vehicles are operated**
- **Lack of technical standards to provide baseline references for performance, safety or testing protocols or procedures**
- **Lack of national standards and diversity of state approaches**
- **Cultural differences between automotive and information technology industries**
- **Self-certification vs. third-party certification**

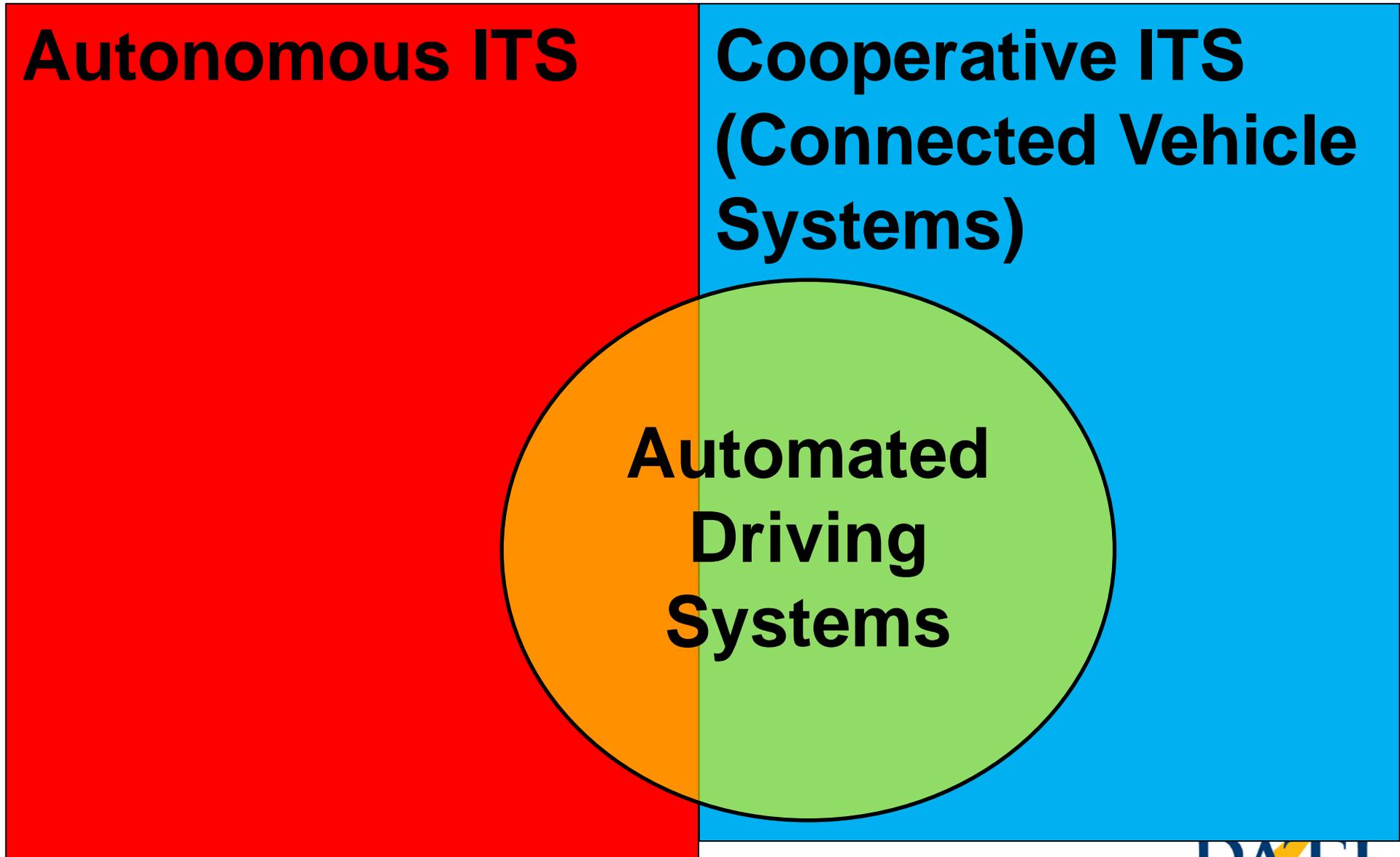
# SAE J3016 Levels of Automation

SAE Level	Name	Narrative Definition	Execution of Steering/ Acceleration/ Deceleration	Monitoring of Driving Environment	Fallback Performance of Dynamic Driving Task	System Capability (Driving Modes)
<i>Human driver monitors the driving environment</i>						
0	No Automation	the full-time performance by the <i>human driver</i> of all aspects of the <i>dynamic driving task</i> , even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	Driver Assistance	the <i>driving mode</i> -specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	Human driver and system	Human driver	Human driver	Some driving modes
2	Partial Automation	the <i>driving mode</i> -specific execution by one or more driver assistance systems of both steering and acceleration/deceleration using information about the driving environment and with the expectation that the <i>human driver</i> perform all remaining aspects of the <i>dynamic driving task</i>	System	Human driver	Human driver	Some driving modes
<i>Automated driving system ("system") monitors the driving environment</i>						
3	Conditional Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> with the expectation that the <i>human driver</i> will respond appropriately to a <i>request to intervene</i>	System	System	Human driver	Some driving modes
4	High Automation	the <i>driving mode</i> -specific performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> , even if a <i>human driver</i> does not respond appropriately to a <i>request to intervene</i>	System	System	System	Some driving modes
5	Full Automation	the full-time performance by an <i>automated driving system</i> of all aspects of the <i>dynamic driving task</i> under all roadway and environmental conditions that can be managed by a <i>human driver</i>	System	System	System	All driving modes

# Example Systems at Each Automation Level

Level	Example Systems	Driver Roles
1	Adaptive Cruise Control OR Lane Keeping Assistance	Must drive <u>other</u> function and monitor driving environment
2	Adaptive Cruise Control AND Lane Keeping Assistance Traffic Jam Assist (Mercedes)	Must monitor driving environment (system nags driver to try to ensure it)
3	Traffic Jam Pilot Automated parking	May read a book, text, or web surf, but be prepared to intervene when needed
4	Highway driving pilot Closed campus driverless shuttle Driverless valet parking in garage	May sleep, and system can revert to minimum risk condition if needed
5	Automated taxi (even for children) Car-share repositioning system	No driver needed

# Autonomous and Cooperative ITS



# Basic Steps in California Process

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- **Sept. 2012 – Legislature created VC38750 and mandated DMV develop regulations by 1/1/15**
- **DMV formed statewide steering committee of affected agencies to provide advice (Caltrans, CHP, OTS, Insurance, NHTSA regional office)**
- **DMV contracted with PATH in 7/13 for technical advice**
- **DMV developed testing regulations, which were adopted 5/19/14. (Testers require state permits as of 9/16/14.)**
- **DMV drafted regulations on public operation, with PATH advice – to be released for public comment soon**
- **Multiple administrative steps required for public operation regulations before adoption 1/1/15**
- **Regulations will be updated periodically**

# Legislative and Administrative Rules

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- **Legislative requirements (in CA Vehicle Code) are legally binding and can only be changed by legislation**
  - **Definitions**
  - **Some specific safety provisions**
  - **Bonding**
  - **Timelines**
- **DMV needs to write administrative rules (in CA Code of Regulations) to implement legislative requirements**
  - **Some specific mandates from Legislature**
  - **Clarifications of ambiguous issues in legislation**
  - **Specific guidance on how to implement legislative intent**

# Systems Covered by Regulations

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- **"Autonomous technology" means technology that has the capability to drive a vehicle without the active physical control or monitoring by a human operator.**
  - **"Autonomous vehicle" means any vehicle equipped with autonomous technology that has been integrated into that vehicle.**
  - **An autonomous vehicle does not include a vehicle that is equipped with one or more collision avoidance systems, including, but not limited to, electronic blind spot assistance, automated emergency braking systems, park assist, adaptive cruise control, lane keep assist, lane departure warning, traffic jam and queuing assist, or other similar systems that enhance safety or provide driver assistance, but are not capable, collectively or singularly, of driving the vehicle without the active control or monitoring of a human operator.**
- This means that SAE Level 3 or higher systems are covered, except:
- **"If the operator does not or is unable to take control of the autonomous vehicle, the autonomous vehicle shall be capable of coming to a complete stop." (which effectively prohibits many Level 3 systems)**
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# Testing on Public Roads (Published)

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- **Legislative:**
  - \$5 M bond/proof of self-insurance
  - Test driver must be designated by manufacturer
  - “The driver shall be seated in the driver's seat, monitoring the safe operation of the AV, and capable of taking over immediate manual control...”
- **Administrative:**
  - Application to test covers specific vehicles and test drivers
  - Many test driver qualifications (driving record, training)
  - No motorcycle, commercial or heavy vehicle testing
  - Prior “controlled testing” under comparable conditions
  - Report total amount of test driving and all disengagements associated with failures or driving hazards
  - (no provision for naturalistic testing with naïve drivers)

# Deployment for Public Operation

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- **Legislative highlights in CA Vehicle Code:**
  - “The AV shall allow the operator to take control in multiple manners, including, without limitation, through the use of the brake, the accelerator pedal, or the steering wheel...”
  - Separate EDR for “autonomous technology sensor data” for at least 30 seconds
  - “The department [DMV] shall notify the Legislature of the receipt of an application from a manufacturer seeking approval to operate an AV capable of operating without the presence of a driver inside the vehicle...”
  - \$5 M bond/proof of self-insurance

# Deployment for Public Operation

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- **Potential administrative regulation highlights:**
    - Identification as AV on registration
    - Specify valid types of driving environments (“areas of operation”)
    - Evidence of minimum behavioral competency for operation in these areas
    - Safety monitoring plan
    - Consumer education plan
    - Information privacy disclosure
    - Vehicle labeling
    - Operator responsibility for violations
    - No special driver training or licensing
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# Additional Issues for Driverless Operations

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- **Special license plate**
- **Emergency stop mechanisms for occupants**
- **Communication to owner/operator for emergency conditions**
- **Owner/operator information available for post-incident data exchanges**
- **Legislature must be notified of application, with 120-day hold period to decide on need for any additional legislation**

# What next?

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- **Further updates of California regulations based on public input, experience in the field, new technology developments**
- **Uncertain prospects for additional state legislation (Google backed off lobbying)**
- **Industry standards development proceeding, but very slowly**
- **Everybody waiting for NHTSA to act (but don't hold your breath)**
  - **Their 5/30/13 policy statement advised states to hold off on authorizing public use of Level 3 or above**