Best Practices for Regulation of

Autonomous Vehicles on Utah Highways

Report to the Utah Legislature

October 2016
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DPS UTAH DEPARTMENT OF PUBLIC SAFETY

A Glimpse into the Transportation Future

Connected and Autonomous Technologies

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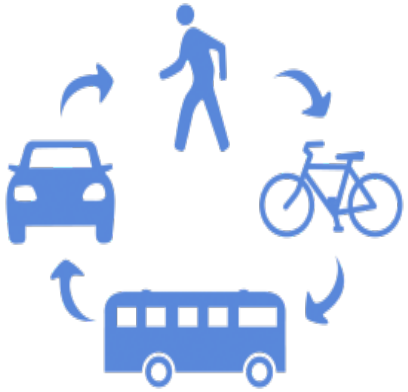
Mission

Innovating transportation solutions that strengthen Utah's economy and enhance quality of life.

Strategic Goals

zero Crashes Injuries Fatalities

Zero Crashes, Injuries, Fatalities



Optimize Mobility

Preserve Infrastructure

Evolution of Transportation

"If I had asked people what they wanted, they'd have said faster horses."

- Henry Ford

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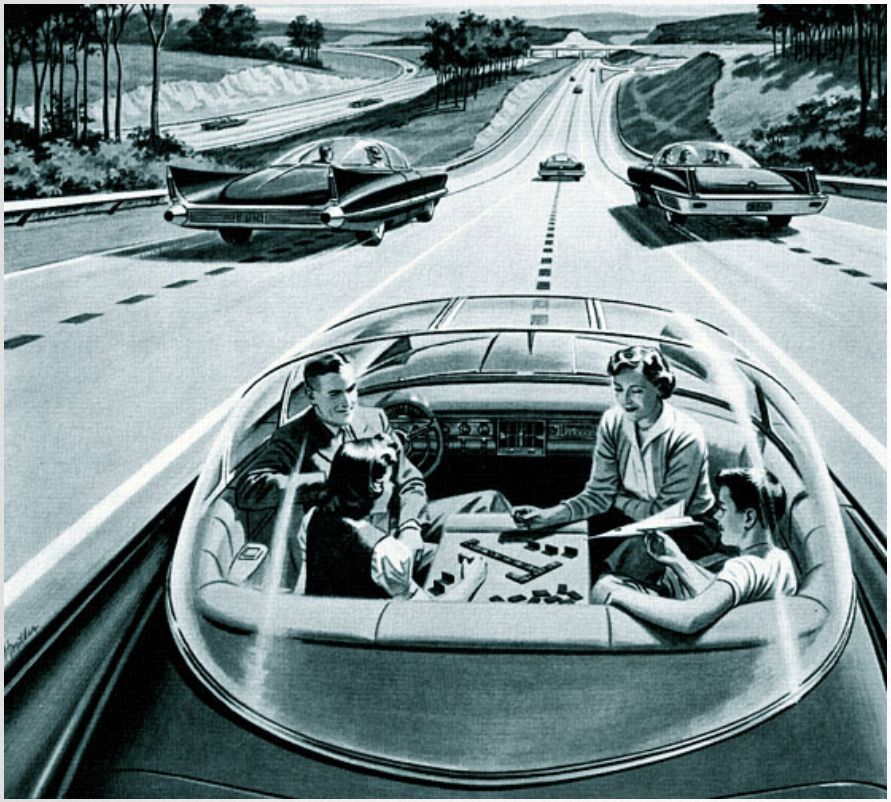
Industry Background & Analysis

Autonomous Vehicles



Electricity may be the driver. One day your car may speed along an electric super-highway, its speed and steering automatically controlled by electronic devices embedded in the road. Highways will be made safe – by electricity! No traffic jams, no collisions, no driver fatigue.

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Automated and Autonomous Vehicles

1.9 million miles - 20 crashes

- Technology motivated by:
  - Safety
  - Reduced energy use
  - Democratization of access

- Drives by sensors:
  - LiDar (64 laser beams)
  - Digital Cameras
  - GPS
  - Radar sensors

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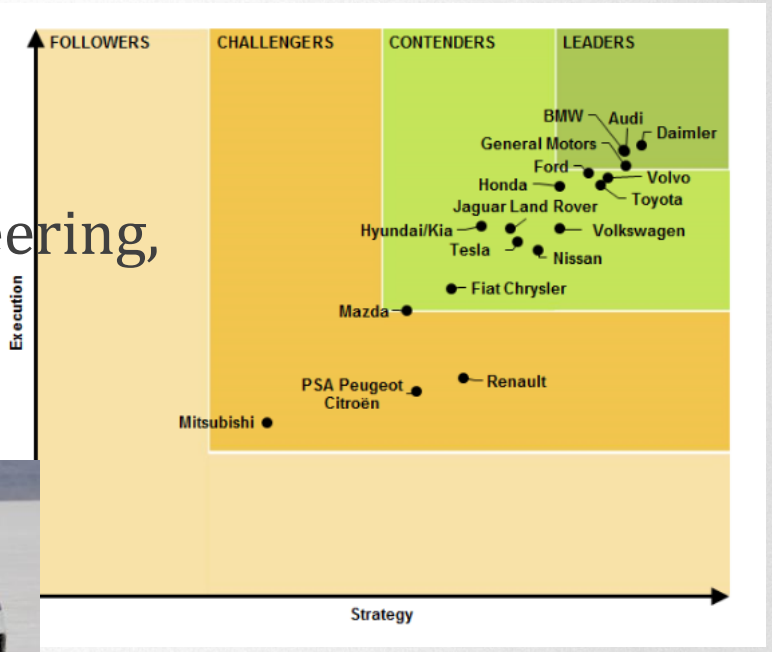
Automated and Autonomous Vehicles

Automated Features Available

- Parallel Parking Assist
- Lane Departure Warnings / "Lane Keeping"
- Adaptive Cruise Control
- Automatic Emergency Braking
- "Traffic Jam" driving: automated steering, braking, acceleration



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Regulatory Guidelines

NHTSA Policy

- Vehicle Performance Guidance
- Model State Policy
- Current Regulatory Tools
- New Tools

NHTSA regulates:

- vehicle performance and safety

States continue to regulate:

- vehicle licensing
- traffic laws and enforcement
- insurance
- liability

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Summary of SAE International's Draft Levels of Automation for On-Road Vehicles (July 2013)

SAE's draft levels of automation are descriptive rather than normative and technical rather than legal. Elements indicate minimum rather than maximum capabilities for each level. "System" refers to the driver assistance system, combination of driver assistance systems, or automated driving system, as appropriate. NHTSA's levels of automation are provided to indicate approximate correspondence.

SAE level	SAE name	SAE narrative definition	Execution of steering and acceleration/ deceleration	Monitoring of driving environment	Backup performance of *dynamic driving task*	System capability (*driving modes*)
***Human driver* monitors the driving environment**						
0	**Non-Automated**	the full-time performance by the *human driver* of all aspects of the *dynamic driving task*, even when enhanced by warning or intervention systems	Human driver	Human driver	Human driver	n/a
1	**Assisted**	the *driving mode*-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 *human driver* perform all remaining aspects of the *dynamic driving task*	Human driver and system	Human driver	Human driver	Some driving modes
2	**Partial Automation**	the *driving mode*-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 *human driver* perform all remaining aspects of the *dynamic driving task*	**System**	Human driver	Human driver	Some driving modes
***Automated driving system* ("system") monitors the driving environment**						
3	**Conditional Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task* with the expectation that the *human driver* will respond appropriately to a *request to intervene*	System	**System**	Human driver	Some driving modes
4	**High Automation**	the *driving mode*-specific performance by an *automated driving system* of all aspects of the *dynamic driving task*, even if a *human driver* does not respond appropriately to a *request to intervene*	System	System	**System**	Some driving modes
5	**Full Automation**	the full-time performance by an *automated driving system* of all aspects of the *dynamic driving task* under all roadway and environmental conditions that can be managed by a *human driver*	System	System	System	**All driving modes**

Automated Vehicles

The New York Times | http://nyti.ms/29dJjPp

BUSINESS DAY

Self-Driving Tesla Was Involved in Fatal Crash, U.S. Says

By BILL VLASIC and NEAL E. BOUDETTE JUNE 30, 2016

DETROIT — The race by automakers and technology firms to develop self-driving cars has been fueled by the belief that computers can operate a vehicle more safely than human drivers.

But that view is now in question after the revelation on Thursday that the driver of a Tesla Model S electric sedan was killed in an accident when the car was in self-driving mode.

Security
Liability
Misuse

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Connected Vehicles

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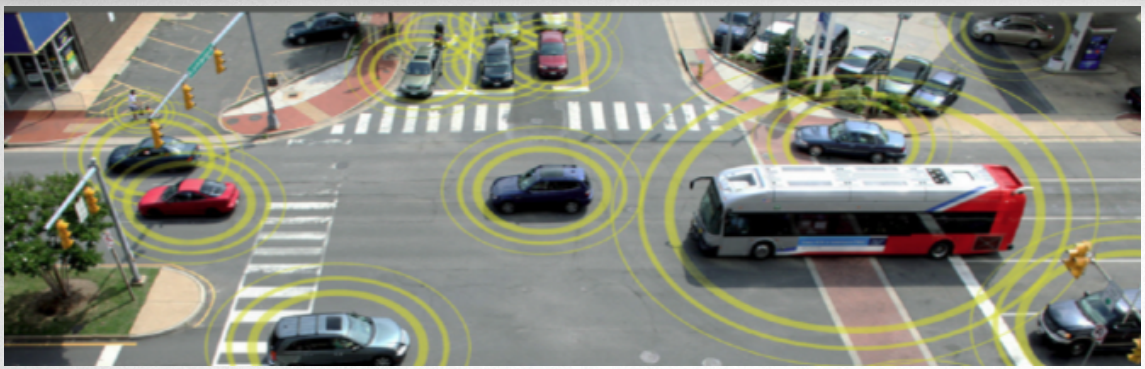
Connected Vehicles



- Vehicle to Vehicle (V2V)
- Vehicle to Infrastructure (V2I)
- Vehicle to Others (V2X)

- The Connected Vehicle system will combine technologies:
  - advanced roadside (and central) infrastructure,
  - wireless communications, and
  - onboard computer processing, and

  to provide vehicles the capability to detect threats and hazards on the roadway and to communicate this to the driver through alerts and warnings.

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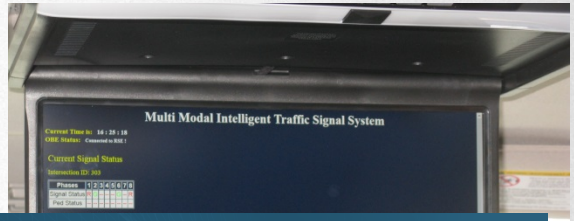
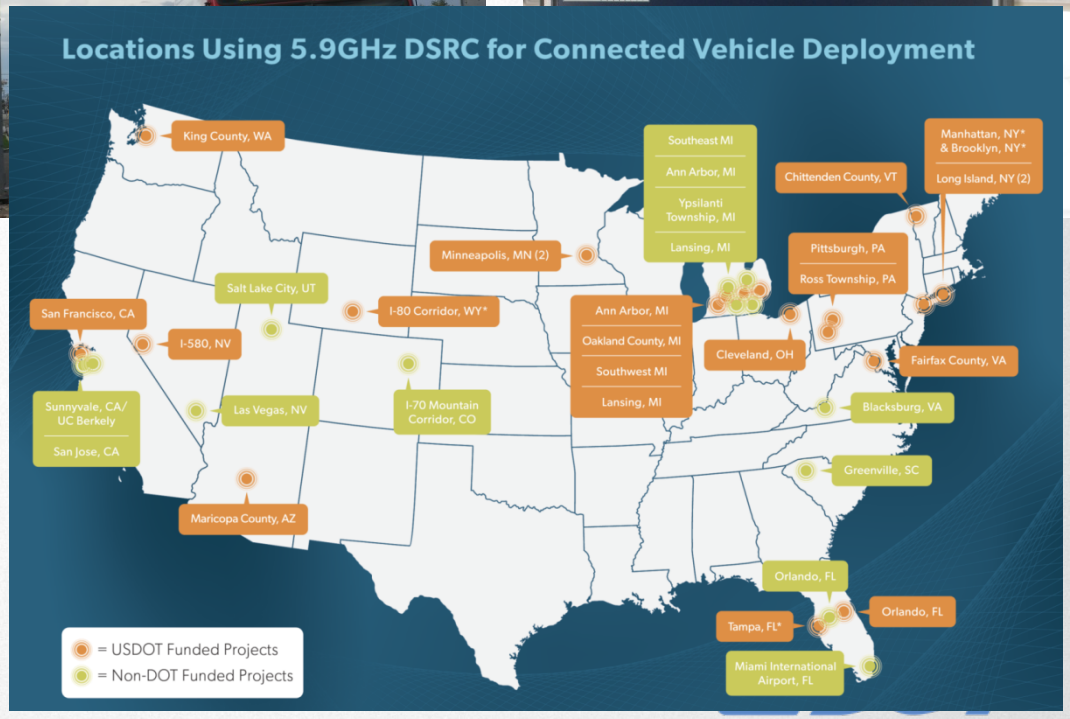
Connected Vehicles

UDOT Connected Vehicle Project – Redwood Road





Connected Vehicles

WIRED — Hackers Remotely Kill a Jeep on the Highway—With Me in It

ANDY GREENBERG SECURITY 07.21.15 6:00 AM

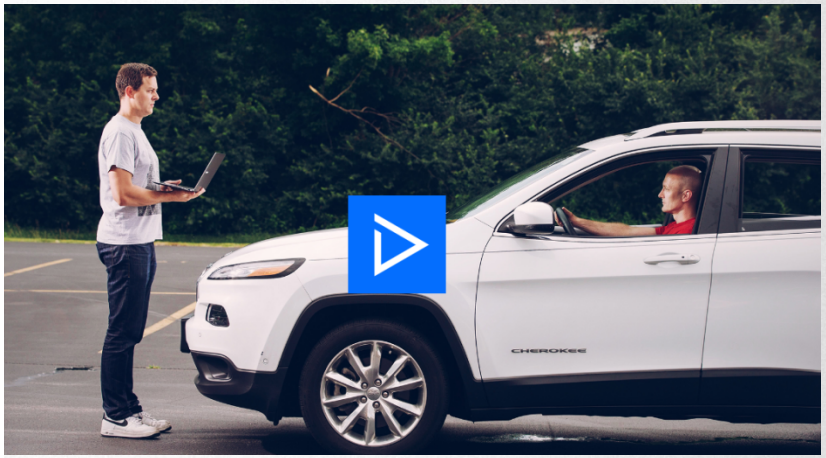
HACKERS REMOTELY KILL A JEEP ON THE HIGHWAY—WITH ME IN IT

I WAS DRIVING 70 mph on the edge of downtown St. Louis when the exploit began to take hold.

Though I hadn't touched the dashboard, the vents in the Jeep Cherokee started blasting cold air at the maximum setting, chilling the sweat on my back through the in-seat climate control system. Next the radio switched to the local hip hop station and began blaring Skee-lo at full volume. I spun the control knob left and hit the power button, to no avail. Then the windshield wipers turned on, and wiper fluid blurred the glass.

As I tried to cope with all this, a picture of the two hackers performing these stunts appeared on the car's digital display: Charlie Miller and Chris Valasek, wearing their

Security
Privacy



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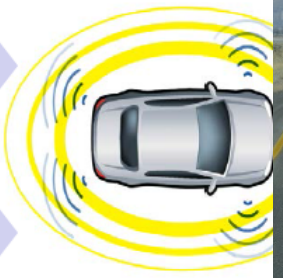
Connected Automation

Connected Automation for Greatest Benefits

Autonomous Vehicle

Operates in isolation from other vehicles using internal sensors



Connected Auto

Leverages autonom
vehicle capabilities

Connected Vehicle

Communicates with nearby vehicles and infrastructure

U.S. Department of Transportation
ITS Joint Program Office

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Summary

- Automated Vehicles are coming incrementally
- Connected Automation provides the highest chance of success
- Technology is evolving fast, but is still evolving
- There are issues to resolve
- We need to leverage the benefits and implement as it evolves

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Licensing, Training & Driver Education

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Recommendations & Considerations

- **Committee for further study**
  - Vehicle safety
  - Data and personal security
  - Infrastructure preparation
  - Training and licensing
  - Vehicle registration
  - Enforcement
  - Regional and national consistency
- **Goals and strategic direction from policymakers**

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