Automated Commercial Motor Vehicles: Potential Driver and Vehicle Safety Impacts

Office of Analysis, Research, and Technology
Federal Motor Carrier Safety Administration

Managing Fatigue Conference Mar 20 -23, 2017
- Measuring fatigue and fatigue risk
- Fatigue detection and management technologies
- Operator workload, including distraction and drowsiness
- Cognitive and other performance effects, work accidents/incidents and commuting crashes
- 15 minutes presentation
Industry Demonstrations of Full Automation

- **Freightliner**
  - Continuing trials in Nevada
- **Daimler**
  - Platoons in live traffic
- **Otto**
  - Over the road demos
- **Mobile Eye / Delphi**
  - AV Package for OEMs
- **Google**
  - Patent for Self-delivery truck
- **SMARTCOLUMBUS**
  - Driver Assisted Truck Platooning
Platooning

- Level 2 - Driver-operated
- Following Drivers under lateral and longitudinal control.
  - Driver are “engaged”
- Under ideal conditions, platooning trucks can travel as close as 36 feet from each other.
Technical Challenges

- Public perception
  - Acceptance of an AV Truck (or *Multiple*)

- Human factors
  - Work load, distraction,
    Re-engagement to the driving task >>>

- Licensing
  - Autonomously Trained Driver?

- Safety
  - Must be no degradation in safety
  - Baseline Data to support safe over-the-road trials

- $ Cost / Benefit $ For Fleets
Technical and Policy Challenges - Continued

- Testing and certification complexity
- Harmonizing State and local regulations
- National Highway Traffic Safety Administration (NHTSA) mandates
- Federal Motor Carrier Safety Regulations (FMCSRs)
- HOS
Driver Re-Engagement

- When the system has to re-engage the driver...
- How quickly can a driver re-enter the dynamic situation?
  - 2 seconds? 4 seconds? 8 seconds?

>>>@ 88 Feet per Second<<<

- We need to understand what cognitive state the driver is in at any given time.
- Does the driver need “alertness assistance”?
FMCSA Projects

- Multi-Modal Driver Distraction and Fatigue Detection and Warning System
- Evaluation of Research on CMV Drivers with Moderate to Severe Obstructive Sleep Apnea
- Naturalistic Driving Research on Driver Fatigue
- Advanced Fatigue Modeling for Individual Differences
FMCSA Projects

- Review of Existing FMCSA Regulations for Potential Challenges with Automated Commercial Motor Vehicles
- Low-Speed Automated Truck Queue at Ports and Warehouses: (with MARAD)
  - Research related studies; feasibility; safety, driver, and operational benefits analyses.
- Commercial Motor Vehicle (CMV) Automated Vehicle Research:
  - Develop a research roadmap to better understand the impacts that this new technology will have on FMCSRs.
- Updates to FMCSRs Due to NHTSA’s Electronic Stability Control (ESC) Mandate
FMCSA Policy Work and Stakeholder Interaction

- Draft policy to supplement NHTSA AV Policy
- Outreach and feedback
- ITF Forum Jan 2017
- Automation meeting Jan 2017
- CVSA Sessions (TBD April 2017)
- Possible Public Sessions
How Do We Inspect Advanced Technology?

VISUAL INSPECTION?

Mandates
- ABS
- ESC
- What’s next?
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EXTRA SLIDES FOLLOW
(use dependent on audience)
SAE Levels of Automation

- **Level 0**: No Automation
- **Level 1**: Driver Assistance
- **Level 2**: Partial Automation
- **Level 3**: Conditional Automation
- **Level 4**: High Automation
- **Level 5**: Full Automation

(Note: The diagram illustrates the progression from human driver monitoring to automated driving system monitoring.)
What CMV-specific technologies for automation exist?
What are specific implications of the range of technology options on infrastructure requirements and human factors?
How do these systems need to be regulated in order to allow safe operation?
What are the policy implications of heavy vehicle automation in order to ensure safe operation?
Connected/Automated Vehicle

- Combining V2V and V2I with AV systems.

Connected Automated Vehicle
Leverages Autonomous and Connected Vehicle capabilities
Multi-Modal Work

“Development of a coordinated message on truck platooning research.”

FHWA - NHTSA - FMCSA
FHWA Projects

- Partial Automation for Truck Platooning:
  - Prime Contractor: California Department of Transportation

- Heavy Truck Cooperative Adaptive Cruise Control (CACC)
  - Prime Contractor: Auburn University

- ITS JPO
  - ICF/Wyoming Pilot Deployment
  - **Objective**: Reduce the number and severity of adverse weather-related incidents (including secondary incidents) in the I-80 Corridor in order to improve safety and reduce incident-related delays.
Commercial Vehicle Automation Today: Level 2

- Automatic emergency braking (AEB) now required on heavy trucks in Europe.

- US Fleets are specifying:
  - Forward collision warning (FCW).
  - Lane departure warning (LDW).
  - Smart Cruise.

- Cars and light trucks
  - Automated braking by 2022
  - NHTSA estimates half of rear end collisions could be mitigated by AEB
### NHTSA Policy

**Figure I: Framework for Vehicle Performance Guidance**

<table>
<thead>
<tr>
<th>Scope &amp; Process Guidance</th>
<th>Guidance Specific to Each HAV System</th>
<th>Fall Back Minimal Risk Condition</th>
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</thead>
<tbody>
<tr>
<td>Test/Production Vehicle</td>
<td>Describe the ODD (Where does it operate?)</td>
<td>Normal Driving</td>
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<tr>
<td>FMVSS Certification/Exemption</td>
<td>Object and Event Detection and Response</td>
<td>Crash Avoidance - Hazards</td>
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<td>HAV Registration</td>
<td>Geographic Location</td>
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<tr>
<td>Data Recording and Sharing</td>
<td>Roadway Type</td>
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<td>Privacy</td>
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<td>System Safety</td>
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<tr>
<td>Vehicle Cybersecurity</td>
<td>Weather Conditions</td>
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<tr>
<td>Human-Machine Interface</td>
<td>Other Domain Constraints</td>
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<tr>
<td>Crashworthiness</td>
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<td>Consumer Education and Training</td>
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<td>Post-Crash Vehicle Behavior</td>
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<tr>
<td>Federal, State and Local Laws</td>
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<tr>
<td>Ethical Considerations</td>
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</tbody>
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**Testing and Validation**

- Simulation
- Track
- On-Road