Evolution of technology for commercial vehicle safety

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International Transport Forum
Commercial Vehicle Roundtable
January 5, 2017

CAVita
Giving life to transformational technology in transportation
Agenda

• A technological tipping point
  – Brought about by CAV
• Imposed on a century-old transportation system
  – The rate of change has changed
• The process of deployment
• Heavy commercial vehicle safety technology, then and now
• CV and AV have specific significance for heavy vehicles
• Embracing “heavy vehicle CAV”
A technological tipping point

- Connected vehicles and infrastructure (CV)
- Automated vehicles (AV)
  - Including highly-automated vehicles (HAVs)
- Surrounded by:
  - Shared Mobility (SM), Big Data, Smart Cities & Communities, Cybersecurity, Internet-of-Things
- Enabled by:
  - Sensors, software, cloud services, computation, robotics, artificial intelligence, consumer electronics
Technology and Policy Driving Mobility

TRB Partners in Research Symposium: Transformational Technologies

Detroit, Michigan – October 31 – November 1, 2016
Century-old transportation system

• Drivers, vehicles and infrastructure
• Tremendous incremental progress
  – For example, crash rates continue to decline
• But not sustainable for another century
• New technologies cut right across the old silos
  – Safety, traffic efficiency, emissions, energy, economics
• The 21st Century mobility system is connected, automated and shared
• Vehicles will be tailored to operating domains and use cases
Key transformational metrics

- Fatalities and injuries
- Delay in traffic
- Energy consumption
- Carbon emissions
- Customer satisfaction
- Supply chain efficiency
The rate of change has changed

- Conventional R&D model is linear: research, prototyping, testing, modification, deployment
- We now need rapid learning cycles based on large deployments
  - This has been the successful model of the auto industry
  - Commercially successful products require multiple cycles of deployment with increasingly large groups of users
- The same model applies to CAV; in addition it becomes a public-private activity, or set of activities
  - There is no rule book for “public-private learning cycles”
  - Current examples include pilots, demos, model deployments, field operational tests, challenges, etc
The process of deployment

- Model deployments (eg. Safety Pilot, Ann Arbor)
- Fake cities
  - Mcity
  - Willow Run (MI), RELLIS (Tx), GoMentum (CA)
- CV pilots
  - NYC, Tampa, Wyoming
- Advanced Transportation and Congestion Management Technologies Deployment Program (ATCMTD)
  - Marysville OH
- Public-private consortia
  - Safety Pilot, Mobility Transformation Center (MTC), American Center for Mobility, RELLIS (Tx), GoMentum, Virginia Automated Corridors, I70 Mountain Pilot
- Smart City Challenge
  - $50M prize
  - One winner out of 78 cities: Columbus
The American Center for Mobility

With:
• DSRC,
• 4G LTE,
• 5G,
• Cyber,
• Cloud
RELLIS Campus at Texas A&M
CV and AV can proceed independently on parallel paths but will converge to produce “connected automation”
Path to CV

**Connected Vehicles**

- Voluntary fitment of V2V and I2V by OEMs
- Aftermarket fitment
- Introduction of V2V rule
  - NPRM released December 2016
- Significant penetration by 2025

**Connected Infrastructure**

- V2I guidance from FHWA
  - Anticipated soon
- V2X pilots (NYC, Tampa, Wyoming)
- AASHTO SPAT challenge
- Actions by State DOT’s, MPOs and cities
- Significant penetration of signalized intersections by 2025
Continuing issues for CV

• Exclusive access to 5.9 GHz spectrum
  – FCC will decide whether to allow multiple uses and to auction part or all of the spectrum (currently reserved for safety applications)

• Cybersecurity & privacy
  – Authority for issuing security certificates
  – Monitoring of security breaches
    • The auto industry has created an Auto ISAC (Information Sharing and Analysis Center) under the Alliance of Automotive Manufacturers
Connected Vehicles

- Voluntary: 0.5 M
  - 2017 - 2021

- Aftermarket: 30 M
  - 2019 - 2024

- Initial mandate: 90 M
  - 2021 - 2026

- Full mandate: 150 M in 2030
Roadside Equipment (RSEs)

- Safety critical signalized intersections: 2017 - 2021
- Intersections and curves: 2019 - 2021
- Initial vehicle mandate: 2021 - 2024
- Full vehicle mandate: 2024 - 2026
- 150,000 in 2030
Path to AV

Automated Features

• Voluntary fitment of automated features by OEMs
• Fitment of automated features under NHTSA agreements
• Significant penetration by 2025

Highly-Automated Vehicles (HAVs)

• Rules of the road at state level
• NHTSA issuing AV interpretations of FMVSS
• USDOT field operational tests (FOTs) – to be announced
• Low-speed trials
• Smart cities deployments
• On-demand fleets in precincts and cities
• NHTSA guidance on highly-automated vehicles (HAV’s)
• Readiness for on-demand mobility services by 2025
Continuing issues for AV

- Occasional engagement of human driver
- Mixed driverless/driven vehicles
- Liability
- Cybersecurity & privacy
- Compliance with federal motor vehicle standards

- No national roadmap to HAV deployment
- Too many questions, inhibiting collaboration
- Shared mobility accelerates deployment, but brings more questions
Convergence of CV and AV paths
HCV safety technology in its own right
Advanced Collision Avoidance Systems (ACAS)

Light vehicle
• NHTSA rulemaking
• NHTSA safety advisories
• Consumer awareness and demand

Heavy vehicle
• NHTSA rulemaking
• Fleet safety programs
CV

Light vehicle
• NHTSA rulemaking
• FHWA guidance
• AASHTO policy studies
• Traffic control and aftermarket products
• Personal devices

Safety focus

Heavy vehicle
• Same platform and infrastructure as LV
• HV-specific applications
• Fleet involvement in chain of communication
• Potential for signal priority
• Platooning leads the way
• Convergence of CV and AV has begun

Freight efficiency focus (and safety focus)
Driver Assistive Truck Platooning

- Fuel savings at 60 mph, 11m gap:
  - following truck: 10.0%
  - lead truck: 4.5%

<table>
<thead>
<tr>
<th>Light vehicle</th>
<th>Heavy vehicle</th>
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<tbody>
<tr>
<td>• NHTSA OEM agreement for AEB</td>
<td>• NHTSA policy applies to HV</td>
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<td>• NHTSA Automated Vehicles Policy</td>
<td>• Path to HAV is more uncertain</td>
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<tr>
<td>• Path to HAV is uncertain</td>
<td>– Transitional, security, liability and ethical questions</td>
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<td>– ODDS and OEDRs differ from those for LVs</td>
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Use cases considered by Volpe/NHTSA

Review of Federal Motor Vehicle Safety Standards (FMVSS) for Automated Vehicles

<table>
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<tr>
<th>Automated Vehicles</th>
<th>Driverless Vehicles</th>
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<tr>
<td>• Highway automation</td>
<td>• Highly-automated vehicle with advanced design</td>
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<tr>
<td>• Driverless valet</td>
<td>• Highly-automated vehicle with novel design</td>
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<tr>
<td>• Truck platooning</td>
<td>• Riderless delivery motorcycle</td>
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<tr>
<td>• Aftermarket highly-automated driverless vehicle kit</td>
<td>• Driverless delivery vehicle (light duty/heavy duty)</td>
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<tr>
<td>• Conventional vehicle with highly-automated OEM kit</td>
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<tr>
<td>• Highly-automated, conventionally designed vehicle</td>
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Smart Cities and Communities

**Light vehicle**
- Avenues for model deployment of CAVs, SM, AFVs and data analytics
- Hard to scale and mainstream nationally

**Heavy vehicle**
- CAV precincts and corridors are more self-contained and permanent
- Equipped trucks can benefit in multiple locations
- Seeking further accommodations once trucks are equipped
Big Data Analytics

Light vehicle
- HAV data will need to be curated and shared
- New independent roles and trust mechanisms to be established

Heavy vehicle
- Sharing of CV and AV data has a bigger purpose
- Public sector investment in supply chain efficiency
  - Which technologies, which benefits?
The case for embracing “heavy vehicle CAV”

- Heavy vehicle CV addresses efficiency as well as safety
- Heavy vehicle AV concentrates on automated features for safety (rather than HAV)
- Specific aspects of CV and AV are brought together; CV and AV are already converging in the form of platooning
- “Heavy vehicle CAV” has universal application in precincts and corridors
- Precincts and corridors are easier to replicate; data supports supply chain efficiency and investment

Move forward on CAV specific to heavy vehicles in precincts and corridors; Prepare for HAV by reducing uncertainty.