Automated Vehicle Technologies in CMV’s

Greer Woodruff, Sr. VP of Safety, Security & Driver Personnel
TRUCKS WILL BECOME INCREASINGLY AUTOMATED IN THE FUTURE

STAGE 0  No Automation
Driver is fully engaged all the time, warning signals might be displayed

STAGE 1  Driver Assistance
Automation of individual function, driver fully engaged – Driver may be "feet off" (when using ACC) or "hands off" (when using Lane Keep Assist)

STAGE 2  Partial Automation
Automation of multiple functions, driver fully engaged – Driver may be both "feet-off" and "hands off", but eyes must stay on the road

STAGE 3  Conditional Automation
Automation of multiple functions, driver responds to a request to intervene – Driver may be "feet-off", "hands off" and "eyes off", but must be able to resume control quickly

STAGE 4  High Automation
Automated in certain conditions, driver not expected to monitor road – Vehicle can operate without a driver in specific situations, e.g. highway driving

STAGE 5  Full Automation
Situation independent automated driving – Driver has no responsibility during driving

Source: SAE; Roland Berger
Driverless automated trucks can significantly change the landscape

Transfer hub model overview

Drayage "last mile"
- Conventional day cab truck pulls trailer to destination

Drayage "first mile"
- Conventional day cab truck pulls trailer from origin to nearest transfer hub (close to interstate)

Transfer hub
- Trailers are switched back to conventional trucks

Autonomous highway segment
- Driverless stage 4 trucks pull trailer to destination transfer hub
- Trucks can potentially run in platoon formation

Transfer hub
- Transfer hubs have direct interstate access
- Trailers are switched from conventional trucks to automated trucks

Source: Roland Berger
Embark Trucks will follow a two phased approach:

- Phase 1: Sunbelt states in 2024+
- Phase 2: Remainder of the Lower 48 in 2026+

> Within each phase, individual lanes will be added to the Embark Coverage Map based on freight volume demand

> Opening only 4% of interstate miles in the US opens up 50% of freight ton miles
## Why Autonomous?

### Potential Results
- Improved safety
- Assists with Labor Shortage
- Improved Efficiency - Lower Cost
- Energy savings

### Concerns
- Cybersecurity
- Public Acceptance
- Job displacement
- Regulatory requirements

### Status
- Driver assist features
- Increasing State acceptance
- Fully autonomous cars available by 2030 or before
- Billions invested
Automated freight vehicle development paths

**STAGE 5**
- Full Automation
  - Established
  - 2020
  - 2022
  - 2024
  - 2026
  - 2028
  - 2030
  - Fully automated vehicles (truck pilot)

**STAGE 4**
- High Automation
  - Real time communication between trucks via V2V/DSRC
  - Highway pilot – driver "alert"
  - Traffic jam assist
  - Highway assist
  - Predictive powertrain control
  - Lane change assist
  - Automated truck platooning

**STAGE 3**
- Conditional Auto.
  - 1) Highway pilot – driver "alert"
  - Highly automated vehicles in confined areas
  - Highly automated vehicles on dedicated roads
  - Highly automated vehicles on open roads (highway pilot)

**STAGE 2**
- Partial Automation
  - Emergency braking
  - ACC
  - Lane keep assist
  - Driver-assisted truck platoon

**STAGE 1**
- Driver Assistance
  - Blind spot detection
  - Collision warn system
  - Lane departure warning
  - Driver monitoring system
  - Traffic sign recognition

**STAGE 0**
- No Automation

Source: ERTRAC; Roland Berger

Graphic shows availability of technology – Timing of adoption strongly depends on legislation.
Due to the higher productivity of autonomous trucks fewer trucks will be needed and the Class 8 fleet composition will change.

Class 8 truck fleet size and composition [m units]

<table>
<thead>
<tr>
<th></th>
<th>Low adoption scenario</th>
<th>Mid adoption scenario</th>
<th>High adoption scenario</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CAGR 1.5%</td>
<td>CAGR 1.4%</td>
<td>CAGR 1.5%</td>
</tr>
<tr>
<td>2019 fleet</td>
<td>3.2</td>
<td>3.2</td>
<td>3.2</td>
</tr>
<tr>
<td>2035 fleet w/o auton.</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
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<tr>
<td>Tractors replaced</td>
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<td>0.8</td>
<td>0.8</td>
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<tr>
<td>Incr. auton. tractors</td>
<td>0.1</td>
<td>-0.7</td>
<td>0.4</td>
</tr>
</tbody>
</table>

> As autonomous trucks can be operated almost continuously, fewer trucks will be needed to haul the same freight.
> Overall growth in freight traffic will still lead to absolute fleet growth, also in high adoption scenario.

Source: Roland Berger
CURRENT AV COMPANY/OEM ALIGNMENT

TORC ROBOTICS ➔ FREIGHTLINER ➔ Aurora ➔ PACCAR

WAYMO ➔ VOLVO

tu simple ➔ NAVISTAR

EMBARK ➔ PACCAR ➔ VOLVO ➔ NAVISTAR
CURRENT AV COMPANY/OEM/CARRIER ALIGNMENT

EMBARK → FREIGHTLINER® → PACCAR → VOLVO → NAVISTAR

tu simple → NAVISTAR → WERNER ENTERPRISES

WERNER ENTERPRISES

U.S. XPRESS

Schneider

UPS
CURRENT AV COMPANY/OEM/CARRIER ALIGNMENT

TORC ROBOTICS

WAYMO

FREIGHTLINER

J.B. HUNT

Aurora

PACCAR

VOLVO

WERNER ENTERPRISES

FedEx

amazon

U.S. XPRESS

DHL

UBER FREIGHT
CURRENT AV COMPANY/OEM/CARRIER ALIGNMENT

- Kodiak
- U.S. Xpress
- Ceva Logistics
- Gatik
- Walmart
AV CARRIER’S PERSPECTIVE

- Motivations to Deploy AV: Safety, Labor Gap, Efficiency/Cost
- AV will be part of the supply chain over next decade
- Forward-leaning, innovative, data driven, transportation and logistics companies will be in the best position to determine where AV should be deployed
- Deployment will be slow and incremental beginning with the easiest operational domain design (Interstate, southern states)
- The transportation ecosystem risk should be evaluated or established with a net overall risk reduction in mind and not necessarily a one-for-one replacement of existing regulations
- OEMs that have relationships with carriers will be the predominant way that AV initially enter the market
- Even with moderate to high adoption of AV, more drivers will be needed to meet demands of economic growth
- Customer collaboration to build transportation ecosystem efficiencies (ie: coordination of loading/unloading, reduced wait times of AV)
- The public will accept unmanned trucks IF they are substantially safer than manned trucks, the data supports it, and the story is accurately told
THANK YOU!
2022 Southeast CMV Safety Research Summit
May 17, 2022
Jeff Loftus, RD&T Chief, FMCSA Technology Division, jeff.loftus@dot.gov
Agenda


• FMCSA ADS regulatory activities

• FMCSA ADS research efforts
Current State of Automated CMV Testing in U.S.

- Number of active CMV tests in US: 38
- Number of automated CMVs being tested: 117
- Number of States with testing: 28
- Number of States with most testing: TX, CA, and AZ
- Partnerships forming between ADS developers, motor carriers, and maintenance networks:
  - Gatik and Walmart
  - Waymo and UPS
  - TuSimple and DHL
  - Locomation and Wilson Logistics, PGT
  - ADS developers and Ryder
- Early deployment sites:
  - Interstate-10
  - Texas Triangle (Dal, Hou, San Ant)
- Driver out testing:
  - TuSimple, 80 mile runs in AZ
  - Gatik, 7-mile loop, 12 hrs/day since Aug 2021 in AR
  - Outrider, 1,000 yard moves at distribution center in IL

Note: Cross-state routes are represented by two points connected by a line (line does not represent actual route).
Source: Volpe, January 2022
FMCSA ADS Regulatory Activities

- Listening Sessions (2017, 2018)
- Request for Comments (2018)
- Motor Carrier Safety Advisory Council (MCSAC) (2017, 2018)
  - 180 comments received
  - Organizations generally supportive
  - Drivers generally opposed
- NPRM (2022)
FMCSA’s ADS Research Scope

- **Conduct research** to inform safety equivalency decisions for waivers, exemptions, and pilot programs

- **Focus efforts** on the intersection of automated CMVs and public safety officials

- **Identify and promote best practices** for industry’s use of automated CMVs
Automated CMV Evaluation (ACE) Program Overview

- Multi-faceted research, development and test program
- Utilization of FHWA-developed open-source software
- Testing of actual vehicles at various locations
- Government, academic and industry partnerships

Focus Areas

Roadside Inspection / Enforcement
Port Drayage
Emergency Response
Work Zones

FY20 FY21 FY22
ACE Research Program Activities

- Developed ADS Research Plan (2018)
- Equipped three trucks with ADS technology (2018-2020)

2021 Accomplishments
- Prototype roadside enf. in-motion automated CMV status checks
- Draft cybersecurity reference testing plans for fleets
- Initiated AV research for emergency response and work zones

2022 ADS Projects:
- Electronic inspections
- Human--ADS team driving
- Human factors in ADS-equipped CMVs
- Automated hazard triangle deployment
ACE Program Demonstration: Law Enforcement Interaction with an ADS-equipped CMV
Law Enforcement Interaction Demonstration

What Participants Will See on Video:

• Tractor-trailer (L3) automation and Law Enforcement vehicle (Tahoe)

• Tahoe requests automation status of tractor-trailer via dedicated short-range communication (DSRC).

• Tahoe receives response that tractor-trailer is L3 automated and follows to request additional information.

Reason for Demonstration:

• To show how the ACE Program can help FMCSA demonstrate proof-of-concept recommendations.
In Motion Electronic Confirmation – Are Any Automated Trucks Out There?
In Motion Electronic Confirmation – “Automated Truck is Within Range”
In Motion Electronic Confirmation – “Query Response Sent”
Law Enforcement Interaction Demonstration Video
Thank You