Trucking Industry in the United States

80% of all cargo is transported by trucks

$726B annual trucking industry revenue

The top 5 trucking companies by revenues:
- $29.8B UPS
- $19.8B FedEx
- $6.2B J.B. Hunt
- $4.8B YRC
- $4.2B Swift

32% of operating expense spent on fuel
37% of operating expense spent on labor

Fact: 93 Billion spent on commercial vehicle crashes in 2011
Market Overview: Freight Trucking Scale and Major Pain Points

- US Freight Trucking: **$726 Billion in Revenues**
  - Fuel Cost: **$100+ Billion** (nearly 30 billion gallons of fuel)
    - **34%+** Operating Costs
  - Crash Cost: **$93+ Billion**
  - Crash Congestion: **113 million gallons of fuel**
  - Typical Fleet Net Profit: **3% or less**

- Preventing Accidents
- Saving Fuel
- Improving Mobility
- Improving Decisions

- Enhanced Fleet Economics & Safety
Connected Vehicle Solutions → Safety + Efficiency

Advanced Vehicle Control

V2V Communication & Sensors

On-Board Safety Systems
Commercial Platooning Builds on Decades of R&D

EU - Platooning Challenge – 2016

Canada - PIT 2009

EU (Sweden) - SARTRE 2009-Present

US – PATH, NREL, etc. ’90s and ongoing

Germany – KONVOI 2005-09

IL-based Navistar in IN - 2015
Driver-Assistive Truck Platooning Market Overview

Many Companies in US, Europe and Asia Testing or Bringing Truck Platooning to Market
Peloton Investor Base Supports and Reflects Pragmatic Approach

<table>
<thead>
<tr>
<th>TRUCKING &amp; TRANSPORTATION</th>
<th>ENERGY &amp; INDUSTRIAL</th>
<th>TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUNGE</td>
<td>bp</td>
<td>intel</td>
</tr>
<tr>
<td>B37</td>
<td>Breakthrough Fuel</td>
<td>Capital</td>
</tr>
<tr>
<td>DENSO</td>
<td>IA</td>
<td>Lockheed</td>
</tr>
<tr>
<td>Lytx</td>
<td>MAGNA</td>
<td>Martin</td>
</tr>
<tr>
<td>VOLVO</td>
<td>Schlumberger</td>
<td>NGP</td>
</tr>
<tr>
<td>omnitracs</td>
<td>UPS</td>
<td>OF ANGELS</td>
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<td>innovation driven.</td>
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FINANCIAL INVESTORS

FINANCIAL INVESTORS

AND VALUED PRIVATE INVESTORS
We Start by Requiring Best-In-Class Safety on Each Truck

Our Focus: Make Each Truck Safer At All Times

- Improved driver awareness & teamwork: shared video, dedicated radio, over-the-horizon alerts
- Collision avoidance and LDW systems always on
- Air Disc Brakes, Electronic Stability Control
- Continuous Safety Monitoring
- Vehicle-to-Cloud Connectivity
- Vehicle-to-Vehicle Communications
- Predictive Maintenance
Peloton Technology: Improving Safety is our North Star

- From NTSB: In 2012, over 1.7 million rear-end crashes
  - almost half of all 2-vehicle crashes
  - 1,705 fatalities and over half a million injuries

- Highway end-of-queue crashes involving commercial vehicles (often with fatigued or distracted drivers) are particularly deadly, such as the 2015 I-16 tragedy in Georgia.
Collision Avoidance Systems can prevent many crashes

- Commercially available radar-based **Forward Collision Avoidance and Mitigation (FCAM)** Systems can dramatically reduce the frequency and severity of these commercial vehicle rear-end crash types.
- Studies have shown great results even for earlier version systems – and these did not brake trucks to a full stop like the new systems used in platooning.
  - UMTRI - Con-way study:
    - 30 months w/ 12,600 tractors
    - 71% reduction in rear-end collisions
  - Volvo/USDOT study:
    - 3 years w/ 100 trucks
    - **80% of drivers preferred to drive w/ collision avoidance systems**
    - 37% reduction in conflicts/hardbraking situations that could lead to collisions
But Safety System uptake in US trucking has been slow

New Class-8 Trucks Sold w/ FCAM System

- EU regulations mandated FCAM systems on all heavy trucks starting in 2015, estimated to save 5,000+ lives per year.

- In US, Passenger car OEMs voluntarily pledged to make FCAM standard on all vehicles by 2022.

- No similar agreement on commercial vehicles in US, and years away from possible mandate.

- Systems can cost $2-3k upfront and have hard-to-measure payback for fleets
Peloton’s Platooning System Requires & Incentivizes Adoption of Best Safety Specs & Systems

• Trucks must have the latest FCAM systems, LDW and air disc brakes, along with Peloton’s Platooning System, in order to platoon.

• In return for spec’ing trucks with FCAM, ADB, and the Peloton System, fleets are able to platoon and save fuel, creating a tangible economic benefit for adopting the latest safety equipment.
Peloton PlatoonPro: Driver Teamwork, Safety, Efficiency

Reduces the braking time from 1.5 seconds to approx 0.03 seconds

- Active Braking Systems linked
- Both drivers steer
- Both trucks save fuel

Platooning only...
- When safe
- Where safe
- How safe

Dynamic adjustment to conditions

Network Operations Cloud

V2V Wireless Link
Pairs of Trucks with Both Drivers Steering At All Times
Enhanced Teamwork & Safety via Cooperative Collision Avoidance

**Front Driver**
- Hands on
- Feet on + Collision Avoidance
- Eyes/Mind on

**Rear Driver**
- Hands on
- Feet off + Collision Avoidance
- Eyes/Mind on
PELOTON TECHNOLOGY

PlatoonPro: Driver-Assistance -- **Not** High Automation
Peloton System: Driver Teamwork Not “Self-Driving” Trucks

• All Drivers steering & in command at all times: **L1 not Self-Driving**

• Only Pairs of Trucks – not longer chains

• Integrated with OEMs

• Trucks require Best-In-Class Safety Systems
  • CMS, ESC, Air Disc Brakes on tractors

• Improved Driver Teamwork:
  • Dedicated driver radio link
  • Shared real-time video and linked safety

• Limited to Suitable Conditions:
  • Multi-lane, divided, limited access highways, in suitable weather and traffic.
Real-time video forward driver’s view

- Look-ahead view of road ahead for rear driver
- Dedicated push-to-talk radio for drivers to share information.
- Each driver looking out for the other.

Enhanced Driver Teamwork & Awareness
Safety: Handling Vehicle Cut-Ins

Driver sees car cutting in and backs off
OR

If driver does not respond, system radar detects cut-in vehicle and automatically begins to back off follow truck

Follow truck will continue to back off to safe manual following distance (100+ ft) and then give full manual control back to follow driver
Safety: Geofenced to Suitable Roads & Conditions

Network Operations Cloud (NOC) & Fleet Procedures limit platooning to:

- Multi-lane, divided, limited access highways
- Moderate or low traffic conditions (and platoons dissolve automatically below 40 MPH)
- Suitable traction conditions and weather
- Appropriate topography (not major grades)
- Geofencing can exclude construction zones, lower capacity bridges, and other specialized areas
Peloton Network Operations Cloud

Internet/Other Data
- Traffic
- Weather
- Construction Zones

Vehicle Data
- Engine
- Drivetrain
- Braking

Platooning Sensors
- Radar
- Video
- GPS

With Drivers
- Link Finding
- Safety Approvals
- Platoon Ordering
- Alerts/Warnings

With Hwy Operators
- Granular Weather
- Hwy Condition
- Accident Patterns
- Congestion Monitoring

With Fleet Managers
- Analytics
- Diagnostics
- Predictive Maintenance
Collaboration with Industry on Best Practices

Our Philosophy and Approach:

1. We use the strongest available, independently audited systems.

2. We encrypt all communication between trucks and with the Network Operations Cloud.

3. All communications are mutually authenticated.

4. We actively monitor for and defend against malicious attacks.

5. Systems are continually improved through automatic updates.
Making Close Following Safe: V2V

- Constant comms between Trucks
- Linked Active Safety Systems benefit both Drivers
- Immediate knowledge of required braking level
- Gap set to support safety
Making Aerodynamic Following Safe: V2V linked Safety

Driver Perception & Reaction Time:
- 2 sec
- < 10th of a sec

Faster than a Driver or Radar/ACC on a single truck

Truck-to-truck wireless link
Enhancing Teamwork

- Teamed Drivers
- Teamed Trucks
- Teamed Systems
Drivers are Key

- Driver-informed Design & Training
- Trained, CDL-certified driver in both trucks
- Both Drivers fully engaged at all times
- Peloton Driver Training Program for each Fleet

“A driver will feel safer behind the wheel because the truck can hit the brakes prior to a human in critical situations...”
Dave Mercer - Peloton Driver (~3 million MTD)
Integration & Safety Validation working with OEMs

- Know when to dissolve a platoon
- Manage and maintain safe following distance
- Exceed automotive grade safety standards
- Listen and address our customer's safety concerns
- Continue to test for edge cases
- Continuous improvement process

ISO 26262
Benefits: Improved Fuel Savings, Safety, Fleet Management

Platooning Reduces Fuel Costs

- 4.5% fuel savings for the lead truck
- 10% fuel savings for the follow truck
- Verified combined fuel savings of 7.25% savings at 40 foot gap at 65 mph (NACFE)
- Corresponding Reductions in GHG & Diesel Emissions

Peloton Provides Value to Fleets

- Economically viable with less than 1 year payback for typical regional or long-haul trucks.
- High-quality data and improved analytics for fleets
- $726 billion U.S. trucking industry benefits by saving on fuel and enhancing individual truck safety
Driver Assistive Truck Platooning: Wider Benefits

• Safety: Crash reduction and crash congestion-related fuel savings
  – NTSB: Widely deployed Collision Avoidance Systems could reduce ~80% of rear-end crashes. NHTSA: Over $3B annual savings and thousands of saved lives possible with full deployment of active safety systems (2015 study)

• Air Quality: Corresponding reductions in GHG & Diesel emissions

• Insight: High quality data generation for fleets & governments

• Mobility: Increased freight efficiency

• Economy: <1 year payback period for typical regional/longhaul trucks
Solid Demand From Top Fleets
Initial Market Deployment

Today: Within Same Fleet
Many Fleet trucks travelling in groups today

Future: Cross-Fleet
Peloton as intermediary
Fleets interested in linking with others

Installation to New Trucks with our Required Safety Spec

Pre-Delivery

Pre-Wiring

OEM Option

Limited Retrofits to Very Recent Trucks -- Not Old Trucks

Collaboration
Truck OEMs + Suppliers + Fleets + Drivers
Top Use Case: Single-Fleet, Hub-to-Hub Routes

Example Strong Customer Profile:

- 50+ “return-to-hub” runs (regional haul)
- Fleet drivers
- Scheduled and manual NOC pairing
- Homogenous tractor configurations
Operational Domain: Multi-lane, Divided, Limited Access Highways
National Context:
No Federal Barriers; Govt-Industry Collaboration

- Driver-assistive truck platooning complies with federal law, and requires no changes for commercial deployment, as confirmed by federal regulators.

- USDOT, USDOE, and others have participated in demonstrations and funded studies to promote and understand the benefits of the technology.

- USDOT’s recent Policy Guidance 3.0 calls on states to remove barriers to truck platooning, stating:

  “States should consider reviewing and potentially modifying traffic laws and regulations that may be barriers to automated vehicles. For example, several States have following distance laws that prohibit trucks from following too closely to each other, effectively prohibiting automated truck platooning applications.” – US DOT Automated Vehicles 3.0, Preparing for the Future of Transportation
National Context: State Following Distance Laws

**Numerical Minimum Following States**
- A defined numeric minimum following distance in 24 states
- Platooning requires change in law

**“Reasonable and Prudent” States**
- A flexible, discretionary standard in 26 states
- Platooning can be legal under current law
National Context: Platooning Allowance Clarified
Highway Issues:
- Allow DATP operations on any limited access, multi-lane, divided highway.
- Allow DATP operations on any lane currently allowable for trucks.

Infrastructure Effects
- FDOT analysis found that well less than one percent of bridges on interstate and turnpike mainlines might be subject to stresses exceeding bridge design specifications with trucks platooning at even a close 30 foot spacing.
- The State can notify system providers and fleets regarding any locations/areas where platooning should be restricted, due to specific infrastructure elements or other factors.

Traffic Interactions
- At high market penetration, simulation studies have shown that platooning would improve flow in heavier traffic, since platooning trucks take up less road space than trucks traveling alone.
- Other modeling found possible negative effects in congested traffic at some types of interchanges – however these are situations in which platoons will dissolve; fuel economy benefits are minimal at lower speeds.
- Traffic interactions during the recent Florida Platooning Pilot operational demonstration, which included interchanges, bridges, Service Plazas, etc. showed smooth dynamics and did not raise concerns.
Outlook

Growing US and Global Activity using Driver Assistive Truck Platooning Solutions:

- **US:**
  - Peloton bringing driver-assistive truck platooning into commercial ops with selected fleets, 2018-2019.
  - DTNA/Freightliner also indicates testing continues.

- **International:**
  - MAN Trucks and Scania beginning commercial test programs with fleets in Germany and Scandinavia.
  - EU Multi-brand platooning project: Platooning by the 6 European Truck OEMs, 2019-2020+.
  - Platooning commercial demonstration programs planned in UK, Australia, Asia.

Key Activity Ahead – Peloton Technology:

- Robust activity continues in California as Peloton continues joint integration and validation work with OEMs.
- Commercial freight platooning activity over the coming months in Texas with major fleets.
- Activity expanding into other states over next quarters in coordination with major fleets.
- Ongoing work with allies to explore platooning allowance in additional states and international markets.
Washington State & Regional Leadership – Next Steps

- Regional Entities involved with Advanced Safety and Truck Platooning include:
  - PACCAR/Kenworth, Peloton Technology, DTNA/Freightliner.
  - Major National and Regional Fleets highly interested.

- DOL Vehicle Technology Testing / Operation Notification Program
  - Peloton & PACCAR submitting notification to begin initial driver-assistive truck platooning activity.

- WA CAV Working Groups
  - Peloton Technology, PACCAR, WA Trucking Association participating in discussions.
  - Exploring options for allowance of future commercial operations at growing scale, 2020+
Backup Slides