Preventing Crashes
Saving Fuel
Connecting Trucks
Presentation Roadmap

1. Market Overview for Driver-Assistive Truck Platooning (DATP)
2. Technology Overview of the Peloton Technology System
Market Movement: Accelerating Global Activity in Truck Platooning Builds on Decades of R&D

EU - Platooning Challenge – 2016
EU (Sweden) - SARTRE 2009-Present
Germany – KONVOI 2005-09
Japan - ENERGY ITS 2009-12
Canada - PIT 2009
US – PATH, NREL, etc. ’90s and ongoing
Market Overview:
Truck Platooning is increasingly widely supported
Many Companies Involved in Near Commercial and/or Development Systems:
Market Overview: Freight Trucking Scale and Major Pain Points

US Freight Trucking: $700 Billion in Revenues
- Fuel Cost: $100+ Billion for nearly 30 billion gallons of fuel
  - 34%+ Operating Costs
- Accident Cost: $90+ Billion and 113 million gallons of fuel
- Industry Net Profit: 3%

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

Enhanced Fleet Economics & Safety
Market Opportunity: Many Types of Fleets Can Platoon

Many Trucks Travel in Groups Today…

LTL (Less than TruckLoad) Fleets:
Trucks travel hub-hub in groups by nature of operations

Private fleets:
Trucks travel in groups on high density corridors

Truck Load fleets:
Growing trend toward relay style operations w/ trucks in groups

…and can adopt platooning with few changes to dispatching
Market Investment: Peloton Strategic Investors

Successfully closed $60 million Series B Funding Round
Peloton Technology:
We Start by Making Individual Trucks Safer at All Times

- Improved driver awareness with video & over-the-horizon alerts
- Active safety & collision avoidance systems always on
- Air disk brakes, ESC, LDW
- Safety monitoring and Event capture
- Vehicle-to-Cloud connectivity
- Vehicle-to-Vehicle communications
- Enhanced predictive maintenance
Peloton System: Only Pairs of Trucks, Not Longer Chains
Peloton Driver-Assistive Truck Platooning System
Improving Safety, Driver Teamwork and Fleet Efficiency

**Active Braking**
Reduces the braking time from 1.5 seconds to 0.03 seconds

**Platooning**
Active Safety Systems linked
Both drivers steer at all times
Enhances team driving
Both trucks save fuel

**Real-time Cloud Supervision**
Platooning only…
- When safe
- Where safe
- How safe
Dynamic adjustment to conditions
Over-the-Horizon alerts and navigation
Team Driving: Enhanced Awareness & Driver Communication

- Live video from other driver’s view

- Look Ahead view of road ahead of lead truck for follow driver

- Both drivers in communication to share critical information
Drivers in Command & Engaged in Steering At All Times

Front Driver:
- Hands on
- Feet on
- Eyes/Brain on

Rear Driver:
- Hands on
- Feet off
- Eyes/Brain on
Safety: Connected Braking

An operator can safely stop without colliding with the preceding vehicle under manual driving conditions only by allowing enough distance for human perception and reaction.

Radar can lessen the assured clear distance needed to safely stop without colliding by automatically reacting to the preceding vehicle slowing.

By using a truck-to-truck wireless link, the follow truck reacts automatically to the activation of the lead truck brakes, before the lead truck actually begins to slow, ensuring no collision between two vehicles even in a full automatic emergency braking (AEB) event.
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
Peloton DATP: Driver Assistance, Not Fully Automated Trucks

Graphic courtesy:

[Image of Peloton Platooning System (Longitudinal Control)]

Driver role levels:
- **Level 0 (Driver Only)**: Driver is continuously exercising longitudinal AND lateral control.
- **Level 1 (Assisted)**: Driver is continuously exercising longitudinal OR lateral control.
- **Level 2 (Partial Automation)**: Driver has to monitor the system at all times and lateral or longitudinal control is accomplished by the system.
- **Level 3 (Conditional Automation)**: Driver does not have to monitor the system at all times; must always be in a position to resume control.
- **Level 4 (High Automation)**: Driver is not required during defined use case.
- **Level 5 (Full Automation)**: System can cope with all situations automatically during the entire journey. No driver required.
Peloton Technology: Improving Safety is our Highest Priority

- 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 reduce the frequency and severity of these commercial vehicle rear-end crash types.

- Con-way study:
  - 30 months w/ 12,600 tractors
  - 71% reduction in rear-end collisions; 63% reduction in unsafe following behavior

- Volvo/USDOT study:
  - 3 years w/ 100 trucks
  - **80% of drivers preferred to drive w/ collision avoidance systems**
  - 37% reduction in “conflicts” (i.e. hard braking, situations that could result in collision)
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 since 2015, estimated to save 5,000 lives per year
- In US, Passenger car OEMs voluntarily pledge 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-Equipped Trucks are Safer Trucks at All Times

- **V2V Platooning Capability**
- **Cloud-Connected Real-Time Alerts**
- **Air-Disc Brakes**
- **Latest Commercially Available FCAM System**

**Save Fuel:** Application of Foundational Equipment to Improve Fuel Efficiency

**Prevent Crashes:** Foundational Equipment and Technology to Improve Driver & Truck Safety
Peloton’s Driver-Assistive Truck 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 proprietary DATP hardware, 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.

Fleet Operations

Platooning

NOC

Hazards

Weather

Traffic

J1939 - DSRC - GPS - Radar - Video
Peloton Technology: Best-in-Class Cybersecurity

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 Center.

3. All communications are **mutually authenticated**.

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

5. Our systems are continually improved through **automatic over-the-air updates**.
Enhanced Fleet Management & Platooning Orchestration: Peloton + Omnitracs

Omnitracs-Peloton Partnership Delivers Unique Synergies and Levels of Platooning

Fleet Managers
Intra and Inter-fleet Platooning Orchestration & Optimization

Customer Back Office
Stop, payload, vehicle, driver and other dispatch information

Drivers
Presented with and navigated to platooning opportunities

Platoon opportunity just past interchange
Fuel savings of 10% on rear truck and 4.5% on front truck
Verified savings at 40 foot gap at 64mph (NACFE)
Further independently testing by US DOE and US DOT
NREL & FHWA tests confirming savings at varying speeds, gaps of 75ft +
Driver Assistive Truck Platooning: Wider Benefits

- **Safety:** Crash reduction and crash congestion-related fuel savings
  - NTSB: Collision Avoidance Systems could reduce ~80% of rear-end crashes. NHTSA: $3.1B annual savings from full deployment of just currently available systems.
  - Con-way (now XPO) reduced crashes 86% by fully deploying active safety systems (FCAM and LDW)
- **Health:** Corresponding reductions in Diesel emissions
- **Insight:** High quality data generation for fleets & governments
- **Mobility:** Increased infrastructure and freight efficiency
- **Economy:** <1 year payback period for fleets
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Market Development: US Freight Arteries
Platooning focus: Multi-lane, divided, limited access highways
Market Development:
State Following Distance Laws: Two Vehicle Code Types

1. Fixed Numerical Minimum Following Distance Rule
   ➢ Requires legislation or waiver

2. Variable and Discretionary “Reasonable and Prudent” Following Distance Standard
   ➢ May obtain administrative acknowledgement that DATP can comply with the law
   ➢ Several states have provided oral affirmation of legality
## Market Development: Industry-Govt Collaboration

Industry-Govt collaboration, establishing best practices & creating deployment pathways

<table>
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<th>Federal/National</th>
<th>States</th>
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| • USDOT (FHWA) platooning projects  
  • CalTrans/PATH/Volvo/Peloton  
  • Auburn/Peterbilt/Peloton  
  • DOE Volvo Supertruck 2  
  • ARPA-E (Purdue-Cummins-Peloton)  
  • USDOT Smart City: SmartColumbus  
  • Industry Standards: ATA TMC  
  • Best Practices/Models for Deployment:  
    • AASHTO (CAV-ELT), CVSA  
    • Dialogue w/ CSG, other associations | • Commercial Approval (8 and rising): MI, TX, AR, TN, GA, SC, OH, NV (6/12)  
• Testing or Trials already allowed/in discussion in 8 other states and rising (AL, AZ, CA, CO, FL, NC, OR, UT)  
• Further State Allowance Activity on track for 2017 - 18 (Legislative or Administrative)  
• State projects: TTI-TxDOT; Port of SD; Denver ATCMTD; New ATCMTD proposals  
• Commercial Fleet Trials in TX – end of 2017  
• Commercial Activation plans in works for MI, OH, PA / Region for 2nd half 2017 |

**Funded Projects with:**
- [US Department of Transportation](https://www.transportation.gov)  
- [Federal Motor Carrier Safety Administration](https://www.fmcsa.dot.gov)  
- [National Renewable Energy Laboratory](https://www.nrel.gov)  
- [Peloton](https://www.pelotonautonomous.com)
Thank You & Discussion

Steve Boyd,
Co-founder & VP External Affairs
steve@peloton-tech.com
www.peloton-tech.com