

Truck and Bus Industry Update

TRB Truck & Bus Technology Subcommittee

Richard Bishop

Principal, Automated Driving Strategy & Partnerships, Bishop Consulting

January 11, 2022



Highly Automated Driving: Fleets First! Robo-delivery, Robo-taxis, Robo-trucks.



- Operations area selected for best fit with tech capability.
- Cost pressure much less than retail model: all about Return on Investment!
- Hands-on, skilled staff provides software upgrades, system safety certification, maintenance, etc.



CTfastrak



Automating the First Bus Rapid Transit Line.

Robotic Research Technology Demonstrating:

- Automated Steering/Braking
- Platooning
- V2V
- V2I
- Precision Docking

Autonomous Capabilities

Increase Efficiency
Improve Connectivity
Increase Accessibility

Robotic Research is the autonomy provider for this Automated BRT project with the Connecticut DOT. In partnership with New Flyer, Robotic Research will automate three New Flyer Xcelsior 40ft buses for revenue service deployment.



First Automated Bus Rapid Transit



First Automated Bus in Revenue Service



First Automated Precision Docking



First Automated Platooning Buses

Goods Transport



Controlled
Environments

Streets

Resource Roads

Highway



Controlled Environments

- Low speeds; dirty, dusty
- Specialized, high user need
- Small market

Outrider.ai: Distribution Yards



Outrider

- Distribution yard ideal for automation:
 - well-defined environments
 - complexity constrained
 - discrete repetitive tasks
- Commercial operations 2023
- Announced customers:
 - Georgia Pacific



Street

- Complex environment
- Low speed
- Customer-facing
- Strong market, growing

Streets: Parcel Delivery B2B



Waymo

- Announced customers:
 - UPS

Streets: Parcel Delivery B2B



Waymo

- Announced customers:
 - UPS



Gatik

- Announced customers:
 - Walmart
 - Loblaw
- 2021: fully driverless operations in Arkansas

Streets: Parcel Delivery B2B



Waymo

- Announced customers:
 - UPS



Gatik

- Announced customers:
 - Walmart
 - Loblaw
- 2021: fully driverless operations in Arkansas



Einride

- Announced customers:
 - Oatly
 - Lidl
 - Coca-Cola
 - GE (USA)

Streets: Parcel Delivery Business-to-Consumer



NURO

- Announced customers:
 - Fry's Food
 - Kroger
 - CVS
- Operating now in several U.S. cities
- \$500M new funding



Resource Roads

- Unpaved roads
- Remote areas
- Medium speed
- Modest market

FPInnovations



- A major Canadian not-for-profit research center.
- Driver shortage is a key pain point!
Automated Follower platooning of interest.
- Launched project in 2021 to adapt commercial systems for rural public roads.
- Tech developer: Robotic Research
- Challenges
 - unpaved roads
 - all-weather conditions (dust, snow)
 - complex truck configurations



Highway

- Well ordered environment
- High speed
- Huge market
- Platooning L1 / L4
- Stand-alone L4 driverless

Truck Platooning Players

LOCOMOTION



ROBOTIC RESEARCH

FORD OTOSAN

TRATON*
G R O U P

DAIMLER TRUCKS*



VOLVO TRUCKS

* No recent press / announcements

Locomation

A Portfolio Approach to Autonomy

Fully Autonomous Solution to be Deployed in Phases

Fastest Path to Market Deployment at Scale
Massive Data Collection

Vast driving experience from convoying
accelerates solo driverless deployments

HUMAN-GUIDED AUTONOMYSM



PHASE 1
2 Drivers Taking Turns



2022

PHASE 2
1 Driver



2023

Cost Savings
Applicability

30%
50%

33%
75%

SOLO AUTONOMY



PHASE 3
No Driver



2024+

PHASE 4
No Driver



2025+

40%
91%

45%
100%



Locomotion

Industry's First and Only Purchase Orders

LOCOMOTION

+



- ✓ *World's first large-scale autonomous truck order*
- ✓ *1,120 trucks with ARC starting in 2022*

Forbes

"Will Truck Convoying Be The First Viable Commercial Application for AV Technology?"

Transport Topics

"Autonomous Tech Company Locomotion Signs Deal With Wilson Logistics"

FREIGHTWAVES

"Wilson Logistics signs on to platooning deal with Locomotion"

LOCOMOTION

+



- ✓ *8-year agreement with a leader in flatbed transportation*
- ✓ *1,000 ARC systems on over 30 ARC segment starting 2023*

Transport Topics

"This partnership allows us to stay abreast of progressive transportation advancements"
- Gregg Troian, President of PGT Trucking

BENZINGA

"At full commercialization, Locomotion's autonomous vehicle technology is expected to produce an estimated 30% reduction in operating cost per mile"

FREIGHTWAVES

"...Locomotion will work in tandem with the PGT Trucking operations team to execute the most efficient freight movements possible"



U.S. Army Procuring “Leader-Follower” Kits



- Different functional specification
 - short to long gaps
 - Level 1 and Level 4
- 100 systems evaluated at Army bases by soldiers.
- **Army program to procure thousands of systems expected in 2021.**



Highway Solo Driverless Truck Players

 **Plus**  **tu simple**  **EMBARK**  **Aurora**

 **Kodiak**  **WAYMO** **E/NRIDE**  **pony.ai**

 **VOLVO TRUCKS**

PACCAR

TRATON

G R O U P

 **TESLA**

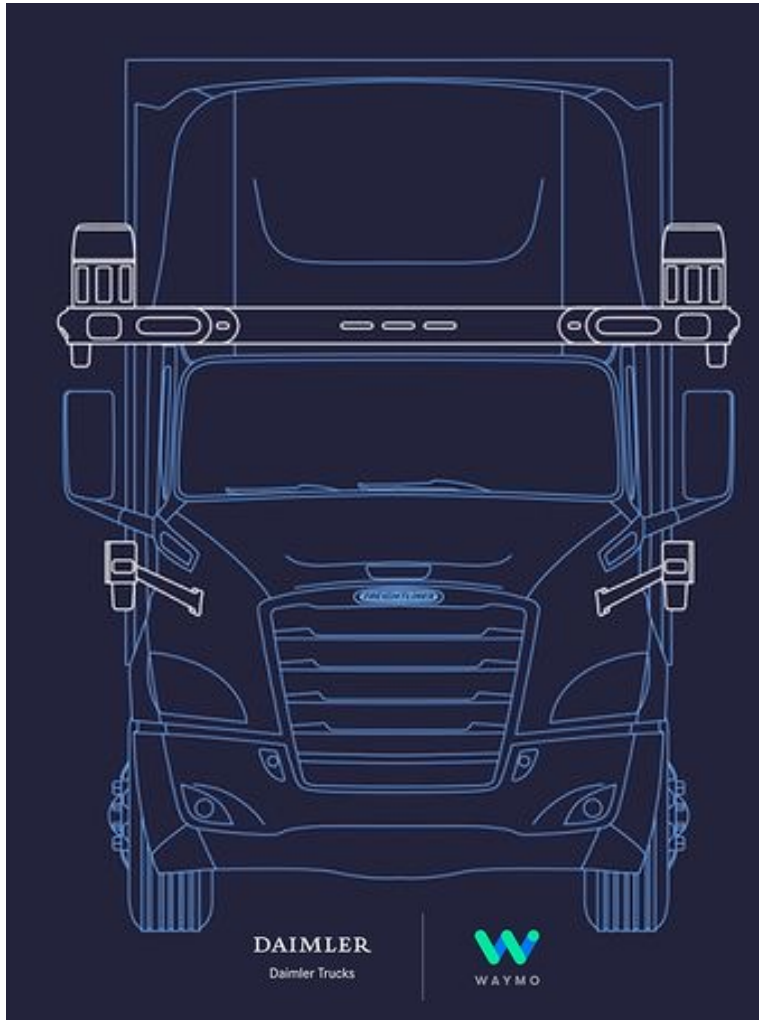
DAIMLER TRUCKS

Solo Driverless Trucking



- Development and Testing
 - Truck automation startups are operating driverless-intent systems on public roads, backed up by safety drivers.
 - Plus
 - PlusDrive supervised autonomous trucks have so far driven over 100,000 km autonomously with zero safety-related disengagements in a commercial pilot with SF Express, China's largest logistics company
 - TuSimple:
 - "driver-out" pilot program late 2021 on 100-mile run between Tucson and Phoenix
 - Truck OEMs: partnering with ADS startups, internal programs

Solo Driverless Trucking: OEM Partnerships



- Redundancy is critical to driver-out operations
- Factory built Level 4 trucks coming ~2025
 - Navistar/TRATON partnership with TuSimple
 - Volvo Group partnership with Aurora
 - PACCAR partnership with Aurora
 - Daimler delivering L4-ready trucks to Waymo
 - IVECO and Plus jointly developing automated trucks to be deployed across China, Europe, and other geographies.
 - FAW partnership with Plus for China market

Volvo-Aurora Advanced Prototype Unveiled September 2021



Solo Driverless Trucking



- Fleet partnerships (*a sampling*)
 - Aurora – FedEx
 - Embark – HP, Ryder
 - Plus – Amazon, SF Express
 - TuSimple – Schneider National, UPS
 - Waymo – JB Hunt, UPS

A “New Species” of ADS Commercial Product: PlusDrive Supervised Automated Driving System

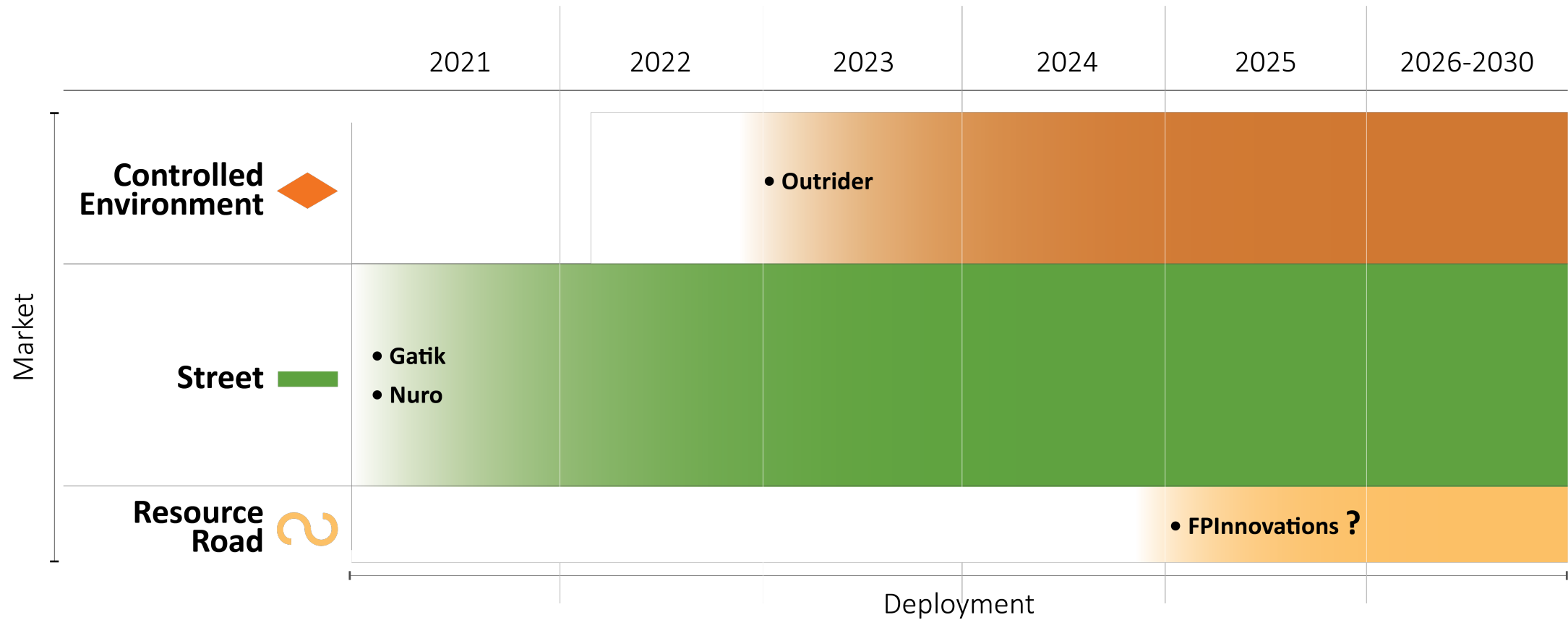


- L4 System operated as L2 by company driver
- 2021 product introduction
- China:
 - Jointly developed with FAW, the world’s and China’s largest heavy-duty truck maker
- U.S.:
 - Integrates with existing trucks
- Deliveries underway in China and U.S. since mid-2021

Pulling It All Together

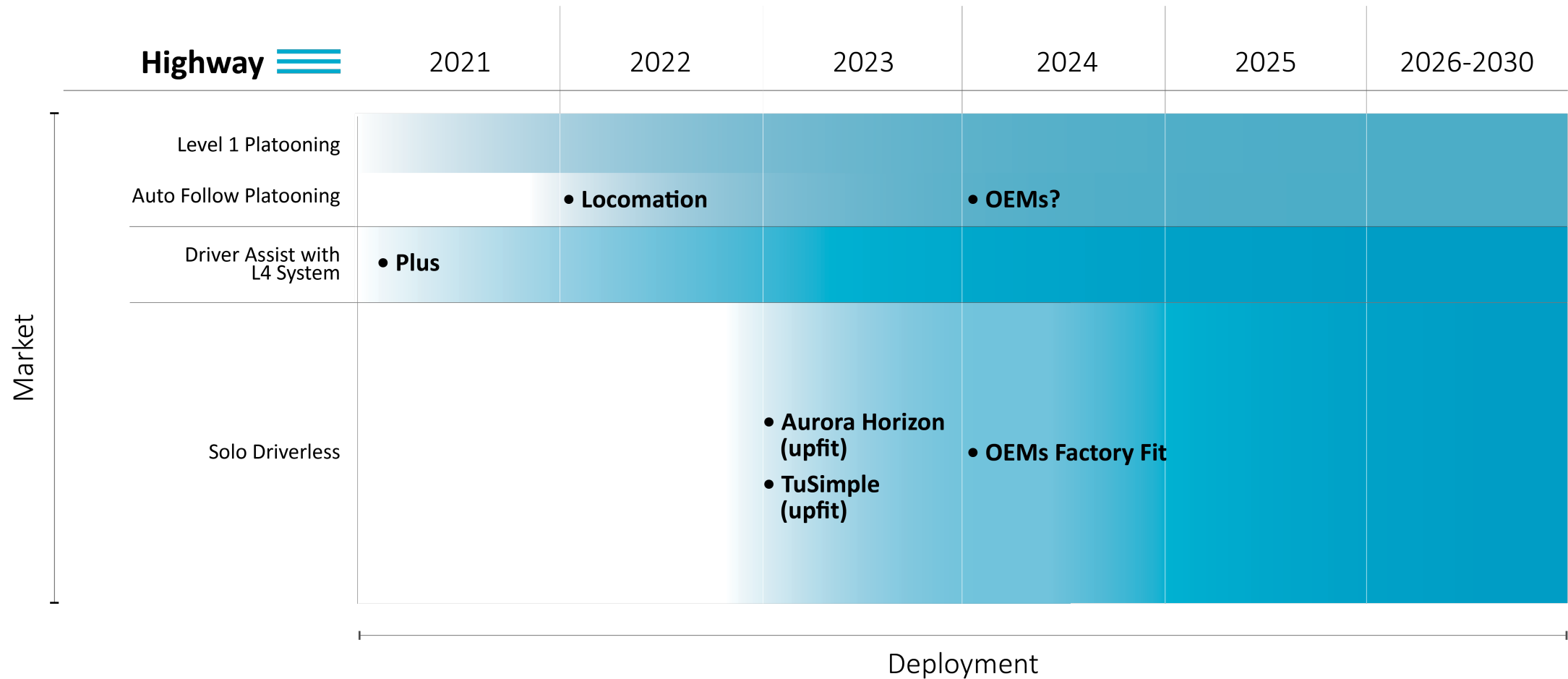
Goods Transport: Driverless Deployment

Size of Market and
Extent of Deployment Over Time



Goods Transport: Driverless Deployment

Size of Market and
Extent of Deployment Over Time



Thank You

Richard Bishop

Bishop Consulting

richard@richardbishopconsulting.com

<https://www.richardbishopconsulting.com>

<https://www.forbes.com/sites/richardbishop1/>

