FTA Transit Bus Automation Research

Office of Research, Demonstration and Innovation (TRI)

Office of Mobility Innovation

ARC Transportation Coordination Committee
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U.S. Department of Transportation
Federal Transit Administration

Why Pursue Transit Bus Automation

Automation has the potential to:

- **Enhance safety and operations** for transit bus services.
- **Improve the mobility experience** for all passengers (enhance or expand service).
- **Promote innovation and transformation** in the transit bus industry.

Image Credit: Beep

Strategic Transit Automation Research (STAR) Program

- Scope & Overview
- Accomplishments
- Lessons Learned

STAR Plan 1.0

- Overview
- Projects

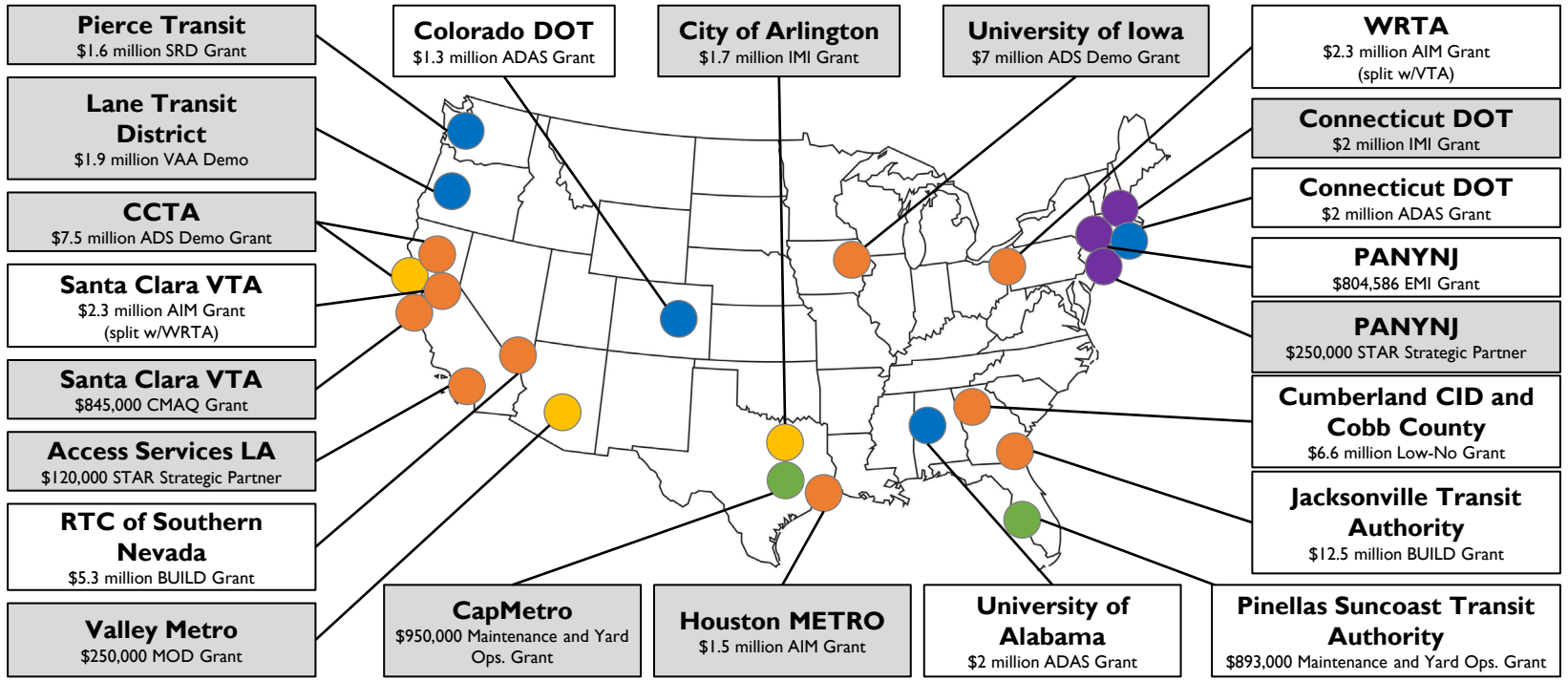
STAR Plan 2.0

STAR Program Scope

- Focused on driving automation in the context of transit bus operations
- Included systems with automated control of functions such as steering, braking, and acceleration (i.e., not just driver warnings), which include:
  - **Advanced Driver Assistance Systems (ADAS)** that help support the bus operator
  - **Automated Driving Systems (ADS)** that drive the vehicle within a defined operational design domain (ODD)
- Defined “transit bus” broadly to include a range of vehicles with different passenger capacities, as well as both traditional and novel vehicle designs

Technology Package	Use Cases
Transit Bus Advanced Driver Assistance Systems (ADAS) (SAE Automation Levels 0-2)	• Smooth acceleration and deceleration • Automated emergency braking and pedestrian collision avoidance • Curb avoidance • Precision docking • Narrow lane/shoulder operations • Platooning
Automated Shuttles (SAE Automation Level 4)	• Circulator bus service • Feeder bus service
Maintenance, Yard, Parking Operations (SAE Automation Level 4)	• Precision movement for fueling, service bays, and bus wash • Automated parking and recall
Mobility-on-Demand (MOD) Service (SAE Automation Level 4)	• Automated first-mile/last-mile • Automated ADA paratransit • On-demand shared ride
Automated Bus Rapid Transit (BRT) (SAE Automation Level 4)	• Automated BRT

FTA Managed Transit Bus Automation Demonstrations



Private-Sector Developer Partners in Demonstrations

- ADASTEC
- Baidu, Inc.
- Blue Space AI
- DCS Technologies, Inc.
- Forterra (formerly RRAI/ Robotic Research)
- Navya Mobility
- LILEE Systems
- May Mobility
- Oxa
- Perrone Robotics
- Southwest Research Institute (SWRI)
- Waymo

Map & Graph Key

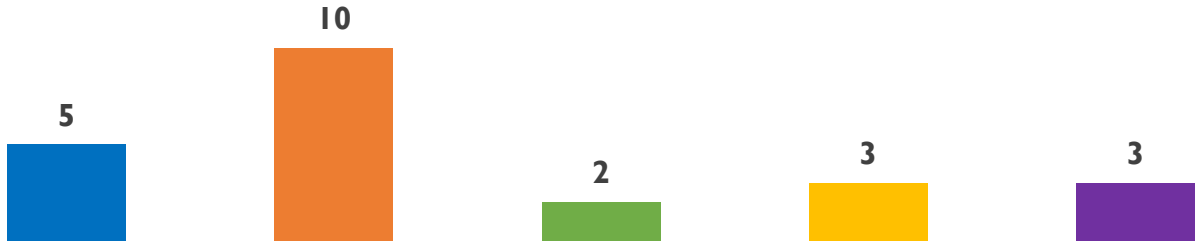
Technology Package

- Transit Bus ADAS
- Automated Shuttle
- Maintenance & Yard Ops.
- Mobility-On-Demand
- Automated BRT

Project Status

- In Planning/Operation
- Completed

Number of Demonstrations by Technology Package



What We Have Learned (Slide 1 of 2)

- Interest
  - ADAS and ADS
  - Range of vehicle types
  - Variety of locations and functions/services

- Challenges
  - Range of ODDs
  - Transit operations include multiple passengers and interactions with vulnerable road users
  - Liability and insurance
  - False negatives and disengagements
  - Immature accessibility functions
  - Setbacks not related to the automated technology

Image Credits: USDOT (top) and Port Authority of New York and New Jersey (bottom)

What We Have Learned (Slide 2 of 2)

- **Industry Ecosystem and Commercialization**
  - Market evolution with new entrants and some exits
  - Early stages of development and commercialization
  - Component technologies maturing and costs declining
  - FTA/USDOT investments support domestic growth
- **Benefits from Demonstrations**
  - Successful proof-of-concepts
  - Positive rider perceptions
  - Increased efficiency
  - Improved mobility
- **Industry Needs from FTA**
  - Leadership
  - Clarity
  - Support

Image Credits: CTDOT (top) and May Mobility (bottom)

STAR Plan 2.0 (2023-2028) Overview

Advance transit bus automation to meet public transportation needs through:

- **Enabling Research:** Conduct research on issues, challenges, questions, and fundamental topics
- **Integrated Demonstrations:** Demonstrate nearly-market-ready technologies in real-world settings
- **Strategic Engagement:** Convene, facilitate, and exchange knowledge with the transit stakeholder community

Enabling Research

Integrated Demonstrations

Strategic Engagement

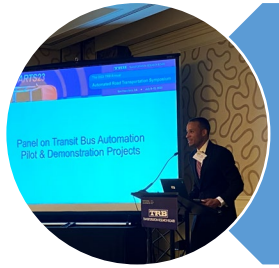
Enabling Research

- Accessibility Analysis
- Human-Machine Interface for Riders with Disabilities
- Market Assessment
- International Lessons Learned
- ADAS/ADS Training Needs
- Changes to FTA Requirements Related to Transit Bus Automation
- Safety and Security
- Finance Options
- Testing Standards
- Business Case Analysis
- Labor Impacts
- Service Patterns and Planning
- Transition Costs and Planning

Integrated Demonstrations

- Maintenance and Yard Operations
- Advanced Driver Assistance Systems
- Automated Accessibility Technology
- ADA Paratransit Service
- On-Demand Microtransit (including Rural Applications)
- Bus Rapid Transit
- Targeted ADAS and ADS Projects

Image Credits: LILEE Systems (top), May Mobility (center), and New Flyer (bottom)



Strategic Engagement

- Knowledge Transfer
- Stakeholder Coordination
- Technical Assistance

Website: https://www.transit.dot.gov/automation-research

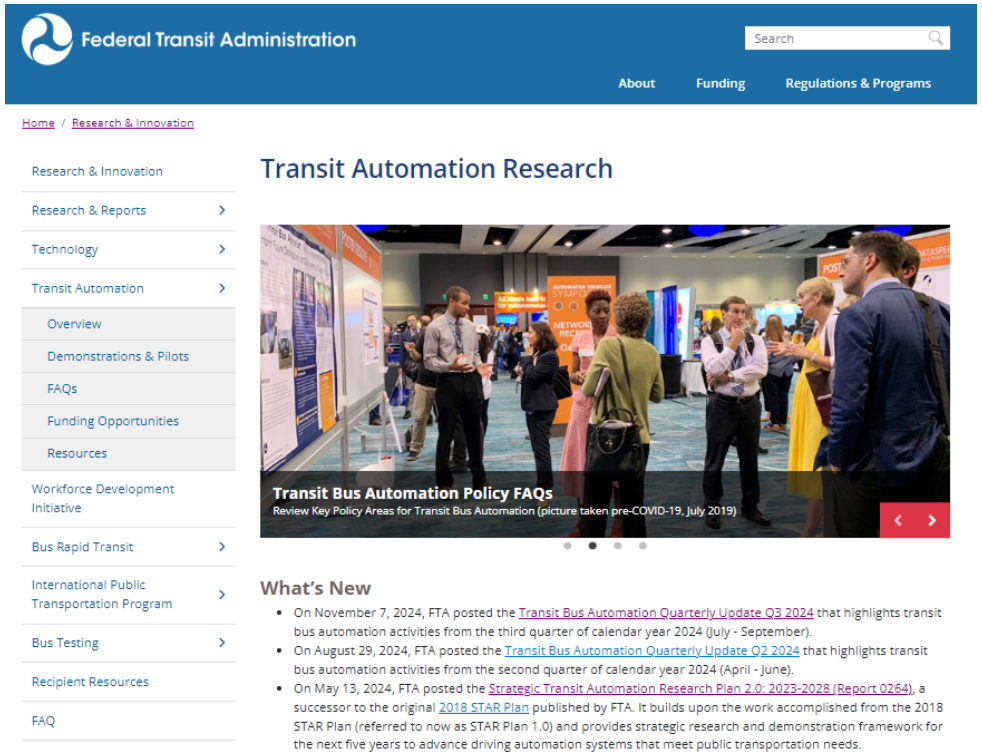


Image Credit: USDOT

Thank you!

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Strategic Transit Automation Research (STAR) Plan 2.0 Roadmap