Challenges of Transferring Automation Technologies from Light-Duty Vehicles and Commercial Trucks to Transit Buses

U.S. Department of Transportation
Federal Transit Administration

Introduction

Can transit buses benefit from the research and development investments being made in the passenger and commercial vehicle sectors?

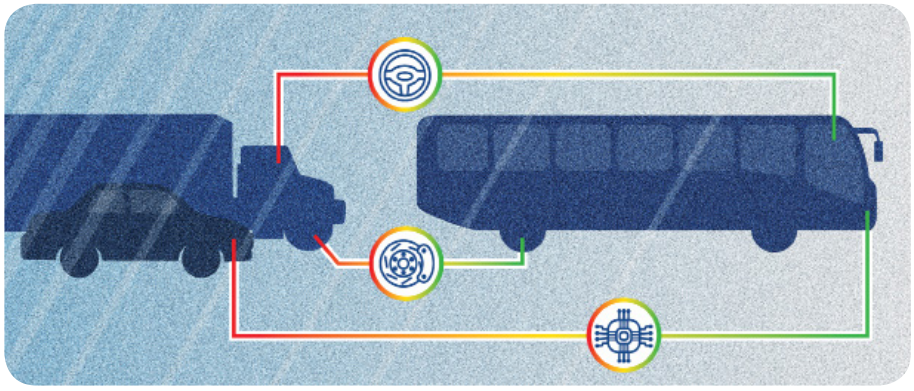
The Federal Transit Administration (FTA) considered the technical and safety challenges of transferring vehicle automation systems from light-duty vehicles and commercial trucks into transit buses and found potential incompatibilities in the technology used in the foundational systems, such as braking, steering, and powertrain. The incompatibilities manifest especially in the control algorithms, sensors, communication of electronic commands, and electronic actuation of those systems.

This fact sheet summarizes the findings of this analysis; the full report provides more information on the difficulty involved in transferring certain automation systems from light-duty vehicles and commercial trucks to transit buses.

Findings

Transferring automation systems from other vehicles to buses requires modification, replacement, or redesign of components and systems. To enable automation, the transit bus industry will need to modify foundational and interfacing systems that can support electronic actuation. Those elements should include:

- Modifications to powertrain systems in support of automation should be more easily made than modifications to other foundational systems (e.g., steering and braking).
- Bus steering systems may require more modification, but heavy-duty vehicle automated steering solutions already exist and may not require extensive changes.
- Implementation of electronic control of transit bus brake systems appears to be a major challenge, as pneumatic brakes found in buses are less conducive to automation and may require extensive design changes.
- Automated applications may require new communication systems architecture with bandwidth to carry numerous complex signals reliably.
- Buses will require new human-machine interfaces to control automation systems, though these should be relatively easy to design and implement.
- Sensors are relatively mature and should be able to be adapted to buses without modification.



Assessment of Automation Systems Transferability to Bus Transit

FTA considered 13 automation systems and assessed their transferability to transit buses. We applied a green-yellow-red grading system to each system based on the range of technical modifications that would be required and the extent of safety issues (see reverse side). Note that a grade of "red" does not imply that the technology is unsuitable for bus transit; rather, simply that it represents a more significant technical challenge.

Automation Grading System

Green	Yellow	Red
Minor modifications to bus systems may be required. Technologies are easily transferable from commercial trucks or light-duty vehicles. The concerns for electronic systems safety are low. The required modifications for design, manufacturing, and cost are simple.	Significant modifications are required to one or more bus systems. Technologies from commercial trucks or light-duty vehicles are transferable, but with major changes to support bus applications. The concerns for electronic systems safety are low to moderate.	New technology may be required to operate one or more foundational bus systems. The automation system cannot be implemented without significant modifications to the technology for several major bus systems. The concerns for electronic systems safety are high.

Automation Systems Considered

System	Affected Systems	Description	Grade
Object Detection and Collision Avoidance (ODCA)	Human-Machine Interface (HMI)*	Provides assistance to driver (via HMI) or higher level automation system to detect objects and avoid collisions	Green
Lane Keeping/Lane Centering (LK/LC)	Steering**	Provides steering torque overlay to prevent lane departure or deviation from central lane position	Yellow
Steering Assist	Steering**	Steers the vehicle without driver's hands on the steering wheel	Yellow
Docking	Steering**	Steers the vehicle to a precise location (e.g., a bus stop at a curb)	Yellow
Park Assist	Steering**	Steers the vehicle precisely into a parking slot selected by the driver	Yellow
Park Out	Steering**	Steers the vehicle out of the parking slot	Yellow
Yard Park	Steering**	Steers the vehicles to a pre-determined location in a specified area	Yellow
Automatic Emergency Braking (AEB)	Braking	Detects imminent forward collision and engages brakes	Red
Reverse Brake Assist	Braking	Detects objects or pedestrians during backward motion and engages brakes	Red
Full Park Assist	Steering, Braking, and Powertrain	Parks the vehicle in a slot selected by the driver. Driver is at the wheel, but automation system controls all movement	Red
Valet Parking (Bus Yard)	Steering, Braking, and Powertrain	Parks the vehicle in a precise location with the driver outside of the vehicle	Red
Adaptive Cruise Control (ACC) with/without Stop and Go	Braking and Powertrain	Controls vehicle speed down to 0 km/hr and maintains safe distance to other vehicles	Red
Traffic Jam Assist (TJA) with Lane Keeping/Lane Centering (LK/LC)	Steering, Braking, and Powertrain	Controls vehicle speed, maintains lane position, and maintains distance to other vehicles in stop and go traffic	Red

* In the standalone warning system, the driver actuates steering, braking, and powertrain.
** The driver is required to provide acceleration and braking control.

For more information:

- Access the full report: FTA Transit Bus Automation Project: Task 10 - Transferability of Automation Technologies
- Contact FTA's Office of Research, Demonstration, and Innovation at transitautomation@dot.gov