FTA Bus Operator Compartment Redesign and Bus of the Future Listening Session and Comment Summary

On June 22, 2023, FTA hosted a listening session focused on the [Bus Compartment Redesign and Bus of the Future Initiatives.](#) The session provided a forum for stakeholders to provide feedback on safety, accessibility, reduction of bus customization, and emerging technologies.

Background

In February 2020, FTA announced the availability of $2 million for research projects under the Bus Operator Compartment Redesign Program. The program was created to improve operator and public safety by reevaluating bus operator compartments and developing innovative solutions.

The research program is partly in response to a Transit Advisory Committee for Safety report, ''[Reinventing and Mitigating Transit Worker Assaults in the Bus and Rail Transit Industry](#).'' The report highlighted news articles documenting bus operator assaults and noted an increase in bus operator assaults. It recommended incorporating measures such as installing protective barriers and educating the workforce in conflict resolution tactics. Transit Operator Assault Events Reported to the National Transit Database were 1.2 per 100 million Unlinked Passenger Trips (UPT) and the number of reported events increased to 4.7 per 100 million UPT in 2020.

Listening Session Summary

WELCOME

Veronica Vanterpool, FTA Deputy Administrator*:

- Welcomed participants and emphasized the value of their participation and input for the listening session.
- Referenced the work of the Office of Innovation in bringing stakeholders – both industry and transit agencies - to share best practices and the findings of their research.

*Deputy Administrator became FTA Acting Administrator in February 2024

SESSION OVERVIEW

Mohammed Yousef- Office of Infrastructure, Safety and Asset Innovation

- Introduced goal of session: to provide information on research to date on bus safety and collect feedback on the bus compartment redesign.
- Provided an overview of the rise in operator assaults, rider expectations, new technologies, and the over customization of buses.

ACCESSIBILITY IN TRANSIT

Dawn Sweet- the Office of Civil Rights Director of HQ Operation

- Discussed value of accessibility for people relying on transit buses.
- DOT requirements and the considerations that will be required in any redesigns, such as requirements that may be impacted if the operator compartment is fully enclosed such as the requirement for personnel to assist with securement for people with disabilities and provide other assistance.

GRANTEE RESEARCH FINDINGS ON BUS COMPARTMENT BARRIERS

Jack Clark, Executive Director of The International Transportation Learning Center

- Provided an overview of their research and recommendations for further research.
- Findings included potential to improve visibility with a camera mirror system and methods to provide better ergonomics for the operator.

Mike Smith, Chief Safety, Security, and Emergency Management Officer for New Orleans Regional Transit Authority

- Presented on a project to install retrofit barriers on existing vehicles and add barriers to new vehicle orders resulting in 154 buses with protective barriers.
- Survey findings revealed a large majority of operators were happy with the barriers.

Bem Case, Executive Director of Innovation and Sustainability and Mike Farhoud, Manager Streetcar Maintenance with Toronto Transit Commission

- Plan to partner on a pending Bus Transit Innovation Project
- Overview of Project: develop design solutions to create a safer, more modern, and inviting experience for operators, passengers, the public, and the environment.
- Summarized feedback from operators about satisfaction with barriers installed on transit agency buses in 2008.

STAKEHOLDER COMMENTS AND DISCUSSION

- Attendees provided comments on four topic areas:
  - operator compartment, safety, protection, and health
  - ADA compliance, universal design, and accessibility
  - passenger compartment, safety, comfort, and convenience
  - customization and emerging technologies
- Stakeholder groups included union representatives, disability community representatives, transit agencies, and transit vehicle manufacturers.
- Stakeholder input was solicited via the Federal Register from June 22-July 24.
- 18 comments were collected during the meeting – the Federal Register comments and comments from listening session are incorporated in the "Comments Summary".

STAKEHOLDER DIALOGUE

Mary Leary, FTA Office of Research Demonstration & Innovation (TRI) Associate Administrator

- Provided overview of the research and innovation activity within TRI and partners.
- Emphasized value of stakeholders and encouraged attendees, including FTA grantees, to share best practices and research approaches.

Comments Summary

FTA received 54 comments were received, 18 of which were received in real time during the listening session. An additional 36 were submitted through the Federal Register. Of the comments submitted through the Federal Register, 24 were scripted letters of support. Below, all comments are summarized by category, including the number of repeated or related comments.

Bus Operator Safety

- **Bus Operator Compartment Perspectives**: 28 comments included a recommendation to fully enclose the bus operator compartment to ensure complete protection against all physical assault. However, 35 comments discussed issues of safety and accessibility of passengers if the operator is fully enclosed. Concerns include the need for the operator to secure wheelchairs, as well as their need to communicate information and provide support to all passengers.
- **Glare**: Bus compartment barriers must not obstruct sightlines, plastic or glass must not produce glare or cause distortions, pillars and other framing structures should minimize visual obstruction.
- **Materials for Operator Protection**: Additional layers of protection in the barrier could include bulletproofing options, Steel frames or other reinforcements, Increased impact force ratings, Locking or secure-access mechanisms for the operator.
- **Use of Artificial Intelligence**: Mobile artificial intelligence technology that can assist in the identification of potentially violent behavioral indicators or detect weapons and alert security/police. These technologies should be capable of mobile deployment on transit fleets and integrate with mobile smartphone technology used by transit supervisors or transit security forces.
- **Window Lock:** Ensure the driver's window be able to lock.
- **Farebox Positioning**: 28 comments recommended that the farebox be either moved away from the operator toward the middle doors of the bus or removed entirely and for removal of fare enforcement from the operator's duties.
- **Bus Door Placement**: Turn the traditional front door into an operator only door with passengers only able to use it as an emergency egress.
- **Technology to Enhance Security**: Include security cameras and panic buttons.

Bus Operator Health

- **Suspension:** 27 comments recommended updating the current straight axel suspension to an independent suspension system to reduce whole body vibration.
- **Mirrors:** Electronically adjustable mirrors.
- **Storage:** Space for driver's personal belongings.
- **Electric Steering:** 2 comments recommended a switch to using electric over hydraulic steering assist.
- **Suspended Pedals:** 2 comments recommended to suspend pedals as they are in cars to prevent ankle hyperflexion and hyperextension injuries caused by floor hinged pedals.

- **Easy Reach Controls:** 2 comments recommended to place controls on the steering wheel or on multi-function posts to eliminate reach requirements.
- **Dedicated HVAC:** 2 comments recommended a dedicated HVAC for the bus operator compartment with high efficiency filtration and fresh air exchange.
- **Worker Protections:** Need worker protections to make sure that operators are not forced to work excessive hours or that their pay is cut.
- **Operator's Seat:**
    - 25 comments recommended updated the driver's seat to reduce vibration.
    - Operator seat options on all transit vehicles should include full adjustability for a variety of heights (forward/backward and up/down), and additional option availability and adjustable ergonomic elements for operator seat tilts and back rests.
    - Drivers compartments for both large and small transit vehicles should allow drivers to comfortably adjust their seat height and distance for pedals/steering wheel, but also allow for individuals of all heights to be able to safely reach and activate all devices located in the compartment.
    - Develop adjustable shoulder strap mounts or attachable seatbelt adjusters specifically designed for transit vehicle to protect the physical health of our operators, reduce distraction while driving, and improve operator compliance with seatbelt laws.

Road Safety

- **Camera Mirror System:** 26 comments recommend replacing mirrors with a camera mirror system to reduce blind spots.
- **Dashboard Display:** 2 comments recommended to include a glass dash design where a camera mirror system is displayed on horizontal monitors on the dash. It would have a configurable central display for critical information like the view behind the vehicle, interior camera views, stop requests or schedule information.
- **Aerodynamic Force Reduction:** Rounding front corners and/or adding turning vanes will reduce destabilizing aerodynamic force on bicyclists and others.
- **Headlights:** Adaptive headlights.
- **Pedestrian Detection:** Electronic pedestrian detection not recommended.
- **Left Pillar Display:** Blind spot detection display on left front pillar not recommended.
- **Single Panel Door:** Switch to a single panel front door to reduce blind spot cause by two-leaf door.
- **Quiet Buses:** Ensure quiet buses are addressed similarly to quiet cars: i.e., minimum standards requiring audible cues outside of the bus.

Accessibility

- **Identify Barriers:** Encourage webinars and trainings to review current requirements, and additional outreach to agencies and advocates to identify current accessibility barriers.
- **Announcements:**

- Automated stop announcements could and should also be deployed on all types of buses and by all transit entities whenever possible.
- Clear audible and visual announcements in all areas of the bus and outside the bus.
- Number and placement of audio signal devices for onboard and external stop and route announcements should be considered.
- **Tactile Maps:** Increased availability of tactile maps on buses and at stops.
- **Accessible Signage:**
  - Clear signage on the interior and exterior of the bus and in maps that is accessible to and developed in tandem with people with intellectual and developmental disabilities, including autistic travelers.
  - Increase size of message screens and make them high-resolution. Please consider MBTA's work to improve on-vehicle stop and route announcements.
- **Emergency Call:** Standardization and/or consistency of accessible emergency call systems on transit vehicles. In many systems a call button may be available to provide voice access to an operator. These systems are not consistently accessible to riders who have physical disabilities, who are Deaf, hard of hearing, or do not speak clearly.
- **Glare Reduction:** Some means to reduce the intensity of the sun in early morning and evening.
- **Cash Dependent:** Ways for passengers who are unbanked or who cannot use electronic payment systems to continue to use cash if needed.
- **Cost:** Affordable and even fare free transit.
- **Accessible Information:** Information about the bus route and stop should be provided in braille and large print at eye or hand level to facilitate wayfinding.
- **Ticket Height:** Onboard Ticket Vending Machine height requirements should be lowered to be 44-46" max height at top operable part to be more useful for those in wheelchairs. There should also be more guidance on where to locate these in relation to stored value card validators.
- **Training:** Make sure that disadvantaged groups and existing operators have access to adequate training on the new buses including just transition to new electric buses.
- **Wheelchair Size:** Redefine measurements for "common wheelchair" as they have gotten larger.

Wheelchair Securement
- **Securement Area Size:**
  - Redefine measurement requirements for compliant wheelchair securement areas. They should include the length of contemporary wheelchair devices and space needed to achieve the recommended angles for safe securement based on "standard" measurements.
  - 4 comments included need for larger securement areas for chair itself as well as space for bags, service dog, etc.
- **Securement Assistance:** Need to ensure driver is available to secure wheelchairs.

- **Automated Securement**: 2 comments recommended automated securement for all wheelchair types.
- **Efficiency:** 2 comments recommended faster more efficient securement systems.
- **Quantity:** 4 comments recommended more fold away seating securement areas.
- **Direction:** Forward facing (in direction of travel) securement areas.
- **Mount Points:** Standardization of securement mount points and/or clear labeling on mobility aids.
- **Wheelchair Entrance:** Move wheelchair securement and entrance to middle door area.

Passenger Compartment Accessibility

- **Stop Signal Pull:** Review location and height of bus stop signal pulls so they are more accessible to those in priority seating areas, especially wheelchairs.
- **Turning Radius:** 5 comments recommended larger turning areas for wheelchairs.
- **Layout:**
  - Review Rehabilitation Engineering Research Center on Accessible Public Transportation drawings and data on different types of layouts and securements.
  - Consider different layouts for priority seating based on disability type and location of dedicated areas for strollers.
- **Doors and Entry:**
  - 25 comments recommended making middle doors the primary entrance point for all passengers including wheelchairs.
  - All doors should be accessible to all passengers.
  - Wider doors.
  - All door boarding and offboarding if a bus makes stop away from a sidewalk or where there is no raised curb.
  - Buses that do not require use of steps.
  - Increase number of passenger doors.

Accessible Technology

- **Fare:** Apps that provide information to blind & low vision passengers including how much money is left on the fare card.
- **Real-time Location:**
  - Ability to track their current location and real-time bus information for both planning purposes and wayfinding on-route.
  - Low-latency real-time vehicle location information and next stop(s) information that is integrated with accessible transit apps.
- **Wayfinding:** Integrate stops and individual buses with wayfinding devices and apps to ensure low visibility passengers can get on the right bus when there are more than one and know they are at the right area of the bus stop.
- **Seat Availability:** 2 comments suggested an app with information on seat availability including wheelchair securement area.
- **Driver Alert:** App alerting driver to passenger's presence at stop if they are unable to clearly signal.

- **Audio Communication:**
  - Improve communication with operator through phased array microphones with noise reflection cancelation. Allow operator to select seating area of interest for specific communication.
  - 2 comments recommended higher quality PA audio.
  - High quality microphone.
- **Door Alert:** 3 comments recommended door opening lights and sounds.

Passenger Compartment
- **Capacity:** One commentor asked if double decker buses help solve the issue of needing more space.
- **Cameras:** 2 comments recommended high quality internal cameras.
- **HVAC:**
  - 2 comments recommended vertical airflow system that goes from a filtered HVAC supply downward and out through the floor for filtration.
  - 25 comments recommended improved HVAC
- **Maintenance:** Self-cleaning technology.
- **Farebox:**
  - 25 comments recommended removing fare collection box entirely or move it to the middle door area.
  - Removal of fareboxes may lead agencies to move towards more fare enforcement causing safety concerns for low-income and people of color.

Technology
- **Payment:**
  - New technologies for fare validation and new forms of fare payment.
  - Touchless fare payment woven into apps and smart card capability.
- **Concerns:**
  - Concerns over the difference in lifecycle between technology and bus.
  - Concern that available advanced hardware is incompletely developed before coming to market.
  - Need increased resources for analysis and certification of hardware.
- **Warning Lights:** 2 comments recommended warning lights on the exterior of the bus.
- **Cost:** Need to focus on designing globally competitive products with offshore licensing to bring down costs of innovation.
- **Artificial Intelligence:** Recommend developing standards to ensure systems relying on AI and algorithms are not replicating bias and are able to detect all travelers.
- **Electric Vehicles:** Consider electric propulsion and optimized input or other methods to make acceleration and slowing as smooth as possible.
- **Automated Vehicles:**
  - Accessibility and the needs of all disabled travelers must be addressed in each USDOT AV related rulemaking, including federal motor vehicle safety standards (FMVSS) updates; ensuring USDOT and the U.S. Access Board have the

resources and staffing to adopt and implement necessary research, rulemaking, and standard setting; and ensuring AVs will complement and improve public transit.

- o Any AV legislation should allow use and permit exemptions of vehicles used in public transportation. AV use in public transportation ensures AV rideshare providers are under clear civil rights law obligations, including the ADA. Without transit and paratransit providers adopting accessible AVs a significant market for AVs is lost.
- o Encourage the FTA to clearly state that whether automated transit buses or shuttles that do not require a driver for bus operation will still require transit personnel on board to assist passengers with disabilities. Recommend research into whether a transit employee should be on every transit vehicle to focus on customer service for all passengers including emergency response.

Customization

- **Obstacles:**
  - o Hard to standardize when all agencies use different technologies and vendors.
  - o Technology changes too fast to standardize.
- **Continuous Improvement:** Standard specifications need processes in place that guarantee continuous improvement that evolves with new understandings of root cause analysis, engineering, and economic modeling.
- **SAE Standards:** Review Society of Automotive Engineers (SAE) standards on the design and implementation of devices that transmit electronic signals and control information among components for customization. SAE J1939 is a higher-layer protocol based on Controller Area Network (CAN). CAN is a serial network technology that can serve as the central communication system for ITS devices (Copperhill Technologies, n.d.). The installation of CAN and mobile gateway routers at the time of build will simplify the integration of other devices. Edge computing can enhance the timely processing of vehicle data in concert with cloud computing. Bus technology specifications should include open data access and disallow proprietary interfaces. In general, standards should be developed to provide frameworks and, when appropriate, restrictions. Standards for technology vendors, bus OEMS, and components suppliers can reduce the negative impacts of customization on transit agency efficiency and budgets.

Other

Financial

- **Assistance Model:** Regulations and financial assistance should move from a competitive basis to an assistance model.
- **Conflicts of Interest:** Remove conflicts of interest in defining bus specifications. Current procurement specifications serve commercial entities interests.
- **Danger of Monopoly:** Tie federal funding to the purchase of vehicles meeting the evolving procurement standard. By providing full funding for a standard bus but

requiring nonstandard options to be funded by someone other than FTA great care will have to be taken to avoid increasing the evolution of monopolistic markets.

- **Low-Competition Environment:** Bus OEMs have limited engineering, research, and development capabilities due to a low-competition environment. Therefore, significant funding and engineering assistance is necessary to assist them in redesign efforts. Because each OEM has existing designs, some will require more intensive efforts to make changes than others, which should be addressed in the distribution of funding. Bus OEMs, along with bus rehabbers, will need to be critical partners in this effort.
- **Incentives:** Create financial incentives for agencies to research and design new, more intuitive, and less bulky securement systems that operators can easily be trained on.

General

- **Public Opinion Research:** 2 comments recommended continued support for independent research that directly collects the experiences and opinions of riders.
- **Union Involvement:** Work directly with drivers' unions throughout the process.
- **Disability Community Involvement:** Include the disability community at the very start of the project.
- **Independent Securement Research:** Recommend research focused on independent securement options for all passengers, including those with disabilities.
- **U.S. Access Board Guidelines:** Refer to the U.S. Access Board proposed rail guidelines for additional ideas regarding increased accessibility in terms of communication and design needs to increase access and comfort.
- **Engagement:**
  - Continued engagement with experts in the field of accessible transit
  - Continued engagement with organizations representing travelers with disabilities and disabled travelers themselves.
- **Universal Design:** Appreciate the addition of Universal Design, it's an important opportunity for working groups to come together to consider how UD can apply to bus design. Consider connecting with the Institute on Human-Centered Design in Massachusetts.
- **Securement Working Groups:** Establish working groups that are comprised of and lead by wheelchair users. Look at aviation wheelchair location/securement/access efforts over the last several years.
- **Stops:**
  - Displays on bus shelters that show bus times both audibly and visually.
  - Universally designed accessible and protected bus stops that are easily identifiable and recognizable to all with covers, benches, and wheelchair spaces.
  - Bus stops and access to these stops must be prioritized during snow removal or in response to other extreme weather events.
  - Better lighting at stops.
- **Service:**
  - Reliable and on time buses.

- On Demand transit buses and paratransit pilots that allow for an increased number of stops and more convenient service.
- Ensure increased frequency does not lead to cuts in service in low ridership areas.

Next Steps

FTA will use these comments and previous research to develop a new NOFO for the Bus Operator Compartment Redesign and Bus of the Future Program. The NOFO announcement will follow standard FTA procedures and will be made available online.

Presentation materials are available in Appendix A. A recording of the meeting is also available online.