HIGH VOLUME TRANSPORT APPLIED RESEARCH

THE URBAN CATALYSTS


# Safe and Secure Public Transport in Delhi

## Use of technology to address the issue of buses skipping stops

August 2024

HVT055 – LC023 – Sonal Shah

DT Global

UK International Development

Partnership | Progress | Prosperity

**Suggested Citation**
The Urban Catalysts. (2024). *Use of technology to address the issue of buses skipping stops*. The Urban Catalysts: Mumbai.

**Acknowledgements**
We are very appreciative of the Delhi Transport Department and the Delhi Transport Corporation for their support throughout the project. Specifically, we are grateful to:

- Shri Ashish Kundra (IAS), Principal Secretary to Lieutenant Governor, Government of the National Capital Territory of Delhi (GNCTD)
- Shri Prashant Goyal (IAS), Principal Secretary and Transport Commissioner, Government of the National Capital Territory of Delhi (GNCTD)
- Smt Shilpa Shinde (IAS), Managing Director, Delhi Transport Corporation

The core team members of this project are: Sonal Shah (Team Leader), Manisha Sharma, Abhijit Sengupta, Sujata Savant and Shradha Gupta. We are grateful to the DT Global team for project management support: Neil Ebenezer (Team Leader), Samuel Fookes and Jeff Turner for his technical reviews.

There are multiple stakeholders who collaborated with us in this project. We appreciate the support by Indraprastha Institute of Information Technology, Tummoc, Delhi Integrated Multi-Modal Transit System Limited, Azad Foundation, Martha Farrell Foundation, Delhi Skill and Entrepreneurship University, Janki Devi Memorial College, TN College of Competitions and Kasturba Institute of Technology.

**Disclaimer**: This technical note is developed based on the learnings from the Safe and Secure Public Transport in Delhi project, funded by UKAID through the UK Foreign, Commonwealth & Development Office under the High-Volume Transport Applied Research Programme managed by DT Global. The views expressed in this technical note do not necessarily reflect the UK government's official policies.

# Table of Contents



# List of Figures



# List of Abbreviations

| | |
|---|---|
| BMS | Bus Management/ Monitoring System |
| DTC | Delhi Transport Corporation |
| GPS | Global Positioning System |

# 1. Introduction

The use of technology in public transport sector presents opportunities for authorities/ operators to optimise service delivery, increase operational efficiency and address systemic issues. For instance, by utilising live data available through global positioning system (GPS) installed in buses, operators can optimise their fleet, plan dispatching of vehicles from depots, and assess and improve driver performance. This not only enhances efficiency but also improves service for users, as GPS availability enables operators to provide real-time information to users, thereby reducing their waiting time.

This note stems from a pilot study conducted on an e-bus route under the "**Safe and Secure Public Transport in Delhi**" project, funded by UK Aid through the HVT Applied Research Programme. The project aimed to leverage the digitalisation of public transport systems to address service gaps and enable a safe travel experience for women and girls. According to the baseline assessment conducted in October 2023, the lack of real-time information and buses not stopping or halting away from designated stops are the predominant issues that female commuters face. Around 39% of the complaints registered with the pilot bus depot of Delhi Transport Corporation (DTC) from July 2023 to October 2023 were that the buses did not stop at the bus stops. This issue not only increases waiting time but also contributes to heightened concerns about safety among female commuters. Specifically, 31% of surveyed female commuters on the pilot e-bus route reported feeling unsafe while waiting at bus stops. Similar issues have been observed in the states/ cities that have implemented fare-free travel scheme (1).

Buses not stopping at the designated bus stops also poses a significant accessibility challenge for persons with disability and elderly passengers since they may face challenges in boarding and alighting. Low-floor buses, which offer steps-free access, are one of the measures Delhi employs to mitigate accessibility issues. However, buses stopping at designated bus stops would enable platform-level boarding, further eliminating accessibility barriers for all individuals.

Due to the integration of multiple technologies, such as GPS tracking system and battery management system within e-buses, public transit authorities are opting for bus management/ monitoring system (BMS) which allows them to monitor technical and other aspects, such as state of charge of batteries, real-time location, speed and performance of bus drivers; and helps them optimise bus schedules.

These guidelines aim to assist public transport authorities and operators on how technology can be utilised to capture and address the issue of buses skipping stops. The recommendation is a 2-step process:

Step 1: Geo-fencing of bus stops

Step 2: Develop a criterion to enable the system to discern when a bus has skipped a stop

# 2. Geo-fencing of bus stops

## 2.1 Step 01: Geo-fencing of bus stops

A geo-fence is a location-based technology that uses GPS or other location-tracking technologies to create a virtual boundary or "fence" around a specific geographic area. When the GPS device enters or exits this virtual boundary, it triggers a pre-defined action or an event.

### 2.1.1 Shape of the geo-fence: Rectangle

It is recommended that the configuration of the geo-fenced bus stop be a rectangle, considering the shape of the bus and the bus box. The use of a circular buffer for geo-fencing should be avoided, as it may lead to overlapping for stops situated on opposite sides of the road, potentially causing false alarms within the system. This could lead to inaccuracies in real-time information and incorrect announcements within buses.

### 2.1.2 Size of the geo-fence: 30m x 6m

The recommended size for geo-fencing of a bus stop is 30m x 6m, considering the average size (12m x 2.5m) of e-buses in Delhi, centred around the latitude and longitude of the middle point of the bus shelter. This depends on the size of the bus stops and buses; cities might need to reconsider their dimensions based on the local context and specific bus stop requirements.

In some locations, multiple shelters are situated at bus stops due to the convergence of multiple routes that follow the same corridor for a short distance before branching off in different directions. Where multiple bus shelters are placed at a single stop, each shelter should have its own geo-fence of the same dimensions.

The length of the geo-fence is determined to ensure that the system captures instances where two (or more) buses stop simultaneously at a bus stop and to minimise the distance commuters need to travel to access the bus from the bus queue shelter, particularly in cases of bus bunching where two or more buses arrive at the same time. Additionally, the recommended width is expanded to accommodate two lanes, considering observed instances of auto-rickshaws/ e-rickshaws or commuters standing in the bus box on the road (Figure 1).

Figure 1: Commuters standing in the bus box at Azadpur, Delhi, while waiting for a bus


*Source: The Urban Catalysts*

#### Illustration of geo-fences

In urban areas, bus stops exhibit multiple configurations, which can be categorised as follows: pole bus stops, bus stops without signage and bus stops with single or multiple queue shelters. For example, some bus stops may be equipped with one, two or three shelters (see Illustrations). The following figures illustrate geo-fencing of different types of bus stops:

Figure 2: Bus stop with one bus shelter

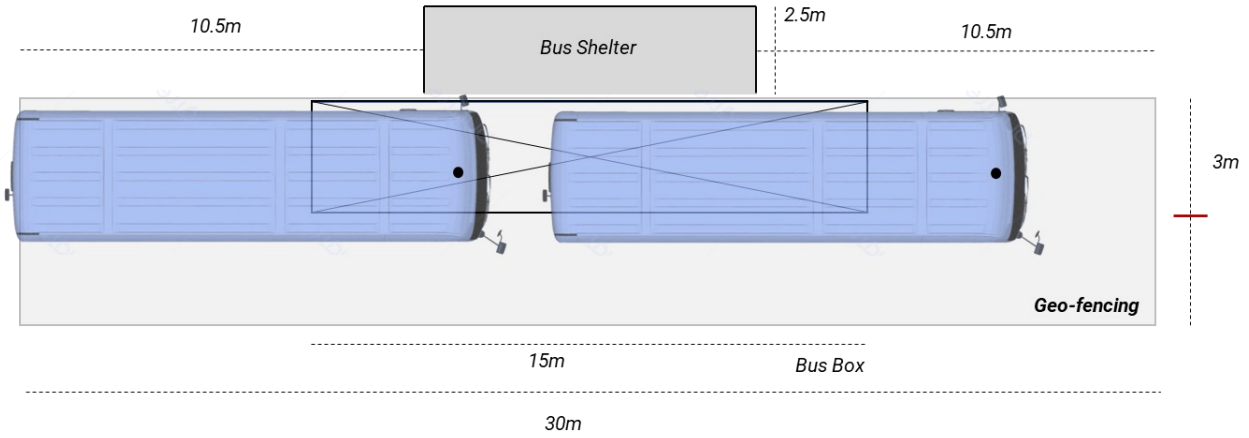
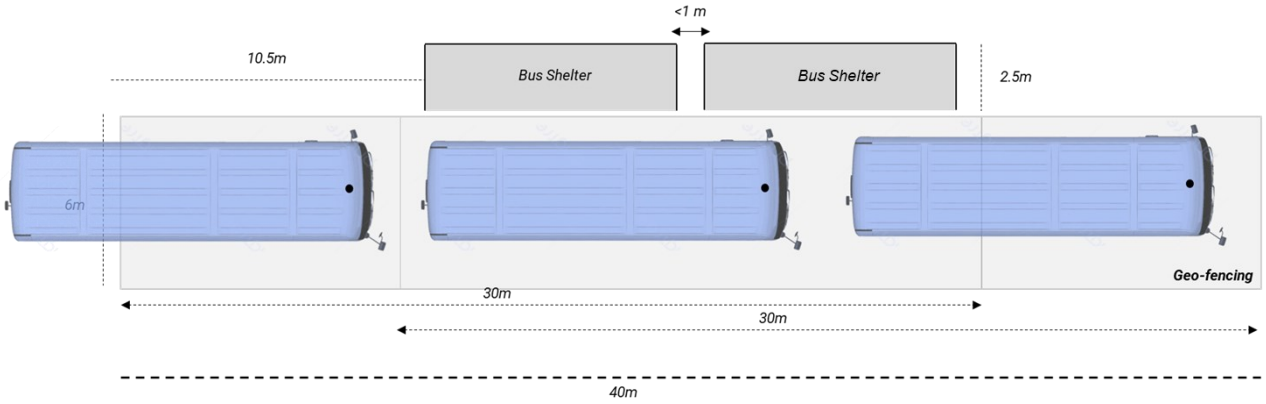
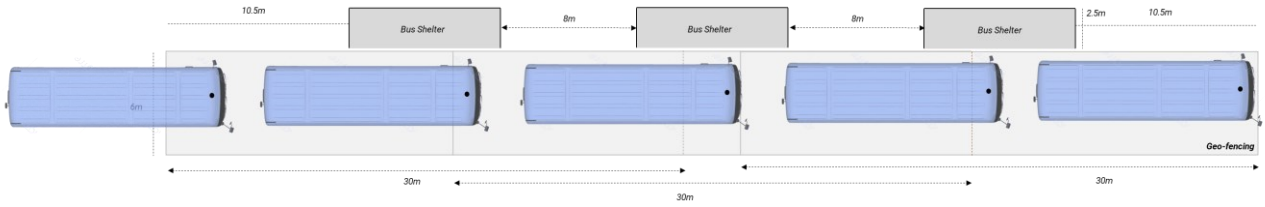



Figure 3: Illustration of a bus stop with two bus shelters




*Note: Shalimar Bagh in Delhi is one such example*

Figure 4: Illustration of a bus stop with three bus shelters




*Note: Wazirpur Depot is an example of a bus stop with three bus shelters*

## 2.2 Step 02: Criteria for the system to determine whether a bus skipped a stop

The criteria would be that the bus must sustain a speed of 0 kmph for average dwell time observed during that time of the day (peak hour/ off-peak hour). Once the geo-fencing is in place, a pilot test should be done to understand the average dwell time at different hours of the day. The dwell time should be periodically observed and adjusted every 3–6 months to reflect changes in footfall and other relevant factors.

For instance, based on the e-bus pilot study, the criteria to determine whether a bus has stopped on route 78 is that the bus must sustain a speed of 0 kmph for 30 seconds within the geo-fenced bus box during peak hours, which are designated as 7–11 am and 4–8 pm. For off-peak hours, the requisite duration is reduced to 15 seconds. This criterion would be monitored for 3–6 months through the assessment of complaints received on a weekly or bi-monthly basis.

# 3. Conclusion

Technology integration in the transportation sector can not only optimise operational efficiency for operators but also help them in improving user satisfaction and safety. Features like real-time bus arrival updates and journey planning directly benefit diverse user groups, especially women, as these features help them reduce their waiting time at the bus stop. Implementing a bus management system can improve monitoring of operations, ensure driver compliance to safety standards, and promptly capture issues like rash driving, route deviation and non-stoppage of buses at the bus stops. However, developing such systems requires careful planning and defining the criteria. Pilot testing the developed criteria, such as determining the speed threshold for rash driving and defining when a bus has not properly stopped at a bus stop, considering peak and off-peak hours, is essential for refinement.

Practical measures like enforcing clear bus lane regulations are crucial to complementing the use of technology. By integrating geo-fencing technology with on-ground initiatives, the transportation sector can effectively enhance safety and service quality for all commuters.

# Reference

1. Chakravarthy R, Seth P. Fare-free Public Transit and Women's Economic Participation: An Analysis of the Shakti Yojane in the Indian State of Karnataka. 2024.

The Urban Catalysts
India

Email: sonal.shah@theurbancatalysts.org
Web: https://www.theurbancatalysts.org/

HIGH VOLUME TRANSPORT
APPLIED RESEARCH

UK International Development
Partnership | Progress | Prosperity