2025 NOCoE Transportation Technology Tournament

CurbCommand ITS: A Real-Time Rideshare and Curb Management System for the 2026 FIFA World Cup at AT&T Stadium – Arlington, Texas

Submitted by:

Mukwaya Arthur Noa
Ngotonie Mark
Ruganuza Denis
Benibo Izison
Kasamala Nancy
Methusela Sulle
Akinbobola Jegede

Advisors:

Dr. Judith Mwakalonge
Dr. Nana Kankam Gyimah

South Carolina State University
May 2025

Contents

List of Figures

List of Acronyms

ITS: Intelligent Transportation System

CDS: Curb Data Specification

BLE: Bluetooth Low Energy

TNC: Transportation Network Company

DOT: Department of Transportation

ATIS: Advanced Traveler Information Systems

ATMS: Advanced Traffic Management Systems

V2I: Vehicle-to-Infrastructure

DART: Dallas Area Rapid Transit

TxDOT: Texas Department of Transportation

NCTCOG: North Central Texas Council of Governments

UUID: Universally Unique Identifier

RSSI: Received Signal Strength Indicator

CIFS: Curb Interface Format Specification

API: Application Programming Interface

GPS: Global Positioning System

COS: Curb Occupancy Status

FIFA: Fédération Internationale de Football Association

JSON: JavaScript Object Notation

HTTPS: Hypertext Transfer Protocol Secure

1 Introduction

Dallas is one of 11 U.S. cities selected to host the 2026 World Cup and will hold nine matches more than any other city FIFA (2025); Staff and Yeomans (2024). This is expected to cause a dramatic surge in traffic, particularly on match days. A critical concern is managing curbside operations for various transportation modes, with rideshare services (Uber, Lyft, taxis) posing significant challenges during peak ingress and egress periods Liu, Qian, Teo, and Ma (2024). Past large-scale events at AT&T Stadium have shown that without proactive coordination, unmanaged drop-offs and pick-ups can severely disrupt arterial traffic, endanger pedestrians, delay shuttles and transit, and leave a negative impression on visitors and residents alike De Alba (2022).

Figure 1: A Map showing AT&T Stadium and Lot N, the rideshare pickup and drop-off zone during World Cup.

One of the biggest problem at AT&T Stadium is its disconnect from major public transit hubs Richie (2023); Sadek (2024). This spatial gap increases dependency on personal and rideshare vehicles. To avoid gridlock and ensure smooth access, a smart, scalable, and cost effective solution is essential. The proposed CurbCommand Intelligent Transportation System (ITS) addresses this need through a real time, tech enabled platform capable of enforcing dynamic curb rules, improving operational efficiency, and providing a seamless travel experience for attendees.

CurbCommand ITS is a digitally integrated system that uses the Curb Data Specification (CDS) for real-time curb rule dissemination Lab (2019a), Bluetooth Low-Energy (BLE) beacons for precise Lot N zone validation shown in Fig 1, and app level integration with platforms like Waze and TNC apps to guide drivers. It also features a centralized dashboard for the City of Dallas DOT, offering real time situational awareness and manual override capabilities. The system delivers targeted benefits for all stakeholders reducing congestion and emissions for residents, improving safety and reliability for transit agencies, ensuring compliance and efficiency for rideshare oper-

ators, and enhancing visitor experience for fans. The CurbCommand ITS will not only serve World Cup needs but also lay the groundwork for sustainable, long-term curb management across Arlington.

2 Problem Description

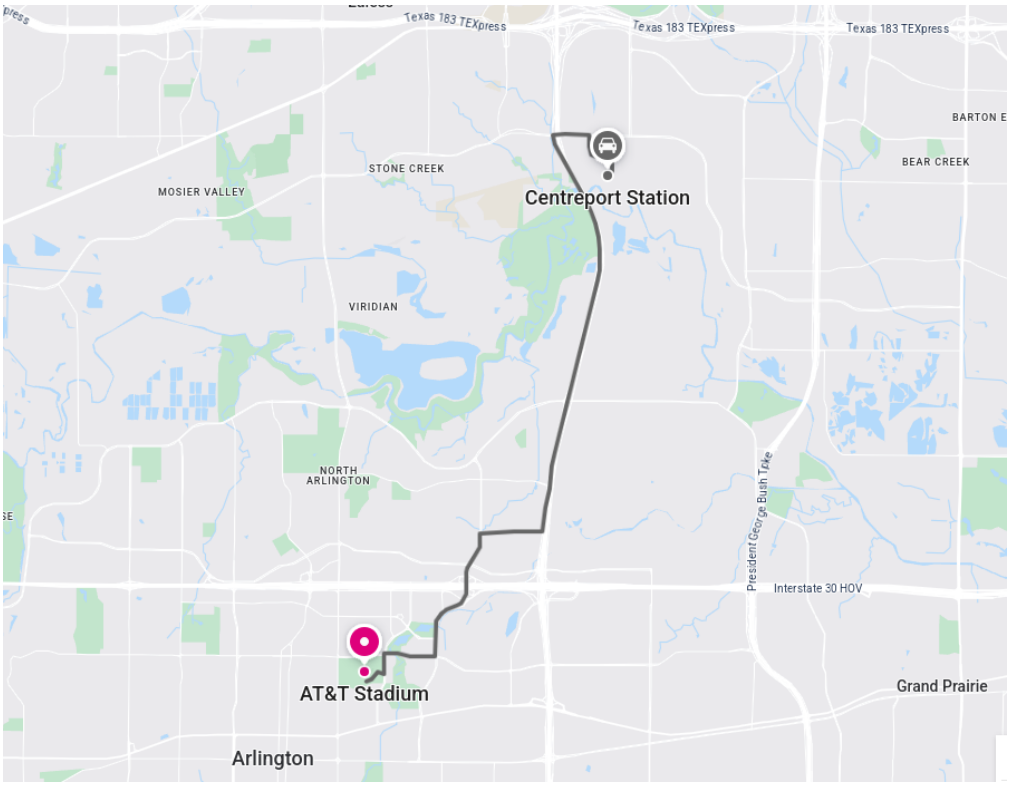

Figure 2: A map showing the 7.8 miles distance from the nearest train station (Centreport) to AT&T stadium

The limited access to public transportation near AT&T Stadium is expected to result in a heavy concentration of rideshare vehicles on surrounding arterial roads during pick-up and drop-off times. With the nearest train station located nearly 7.8 miles away , as shown in Fig 2, fans are likely to rely heavily on rideshare options. This surge in vehicles, if left unmanaged, could severely disrupt traffic flow, pose safety risks for pedestrians navigating the area, and delay essential transit services, including event shuttles.

Traditional geofencing tools used by Transportation Network Companies (TNCs) such as Uber and Lyft have proven insufficient in similar high-demand settings Lab (2019b). Each TNC operates its own closed, uncoordinated system, leading to inconsistencies in coverage and enforcement. Even when geofences are active, there's no assurance that drivers will follow them, which often results in unauthorized stops and added congestion.

These issues are further complicated by the logistical constraints facing the City of

Dallas ahead of the 2026 FIFA World Cup Brown (2025). Budgetary limits and a condensed preparation timeline make large scale infrastructure upgrades infeasible. This highlights the urgent need for a solution like CurbCommand ITS, an intelligent, cost-effective system that enables real-time curb management for large events.

3 Proposed Solution

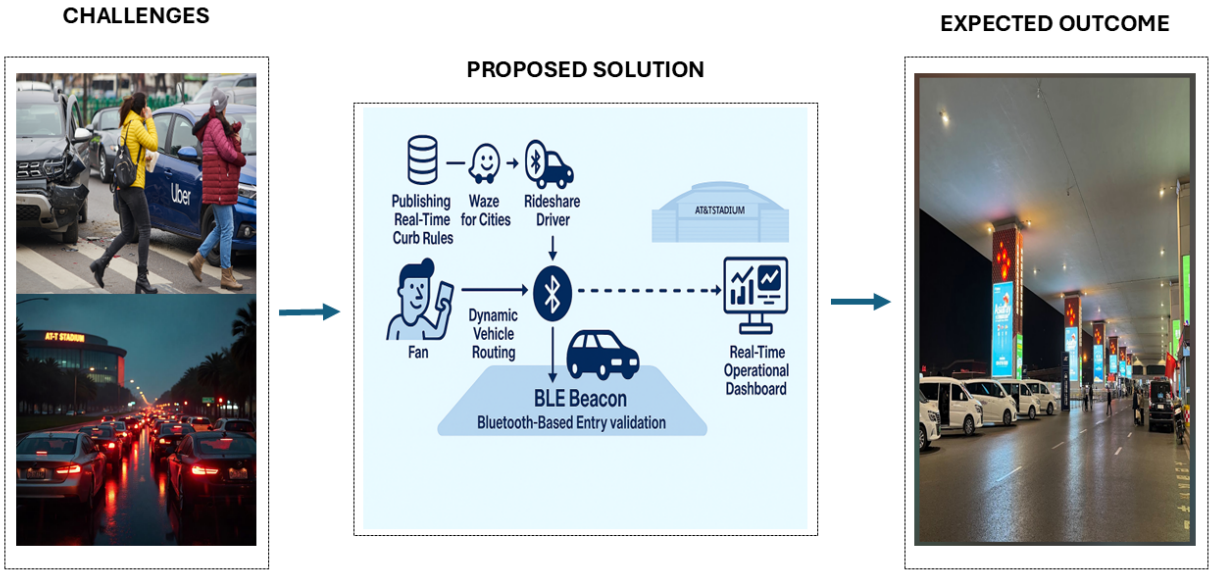

Figure 3: Overview of the proposed solution showing the integration of real-time curb rules, Waze for Cities, and BLE beacons to manage rideshare at AT&T stadium

CurbCommand ITS system integrates several key technological components to achieve real-time control and enforcement of curb behavior. At its core, CurbCommand ITS operates by unifying real-time curb rule publication, dynamic vehicle routing, BLE-based micro-location validation and app-based navigation systems as shown in Fig 1. This multi-faceted approach aims to create a seamless and efficient flow of rideshare traffic while ensuring safety and minimizing congestion. The technologies used by the system include:

- **Advanced Traveler Information Systems (ATIS):** Provides real-time curb usage rules and routing guidance to drivers through navigation apps like Waze
- **Advanced Traffic Management Systems (ATMS):** Supports centralized monitoring and control of curb zones via a dashboard operated by the City of Dallas Department of Transportation.
- **Bluetooth Low Energy Technologies:** Enables micro-location validation of vehicles arriving at designated pickup/drop-off Lot N zone.

- **Vehicle-to-Infrastructure (V2I) Communication:** Facilitates real-time communication between vehicles and roadside infrastructure to enforce curbside compliance.
- **Mobile and Cloud-Based Integration:** Ensures scalable, distributed computing for data sharing, navigation integration, and system-wide coordination.
- **Open Data Standards - Curb Data Specification (CDS):** Promotes interoperability and standardized curb rule dissemination across platforms.

The technical description of how the system will function is presented below, detailing the process of operation:

3.1 Publishing Real-Time Curb Rules:

The foundation of CurbCommand ITS is the real-time publishing of official curb regulations. City of Dallas DOT will host a CDS feed. This feed will define the permissible curb activities (e.g., loading zones, no-stopping areas, designated pickup/drop-off locations) based on specific locations and times SharedStreets (2025). A crucial aspect of this approach is that all relevant applications, including those used by Uber, Lyft, taxis, as well as popular navigation apps like Waze and Google Maps, will be able to dynamically ingest these rules. This ensures that all drivers receive consistent and up-to-date instructions regarding where they can and cannot stop, load, or unload passengers, without the need for separate and potentially complex negotiations with each individual transportation company. The existence of resources and users associated with the CDS standard validates the feasibility and potential for widespread adoption of this approach.

As shown below in this sample extract, the CDS feed includes three curb enforcement points near AT&T Stadium, designating Lot N as the only permitted Drop-off / Pick-up Zone, while Points 1 and 2 enforce a no-stop policy with redirection to Lot N.

- 950 Cowboys Way — No Drop-off / Pick-up. Redirect to Lot N
- 301 W Randol Mill Rd — No Drop-off / Pick-up. Redirect to Lot N
- Lot N — Designated Rideshare Drop-off / Pick-up Zone

GeoJSON Snippet


```
{
  "type": "FeatureCollection",
  "features": [
    {
      "type": "Feature",
      "geometry": { "type": "Point", "coordinates": [-97.093663, 32.745551] },
      "properties": {
        "location_id": "point-1",
        "name": "950 Cowboys Way",
```

```
        "curb_policy": "No Drop-off / Pick-up. Redirect to Lot N"
      }
    },
    {
      "type": "Feature",
      "geometry": { "type": "Point", "coordinates": [-97.109611, 32.750112] },
      "properties": {
        "location_id": "point-2",
        "name": "301 W Randol Mill Rd",
        "curb_policy": "No Drop-off / Pick-up. Redirect to Lot N"
      }
    },
    {
      "type": "Feature",
      "geometry": { "type": "Point", "coordinates": [-97.085763, 32.755694] },
      "properties": {
        "location_id": "point-3",
        "name": "Lot N",
        "curb_policy": "Designated Rideshare Drop-off / Pick-up Zone"
      }
    }
  ]
}
```


3.2 Waze for Cities:

To effectively guide rideshare drivers towards the designated pickup and drop-off locations, CurbCommand ITS will integrate with the Waze for Cities API Waze (2025). By consuming the CDS data, Waze can access the official, real-time regulations governing curbside activities around AT&T. This enables Waze to dynamically update its routing algorithms and provide drivers with navigation instructions that comply with the current curb rules, directing them to Lot N and away from restricted zones. Concurrently, the Waze for Cities program facilitates a two-way data flow where cities can push information like road closures and re-routing instructions via the Waze for Cities API, complementing the static and dynamic rules provided by the CDS feed and further influencing driver guidance within the application. This synergistic integration ensures that drivers using Waze receive accurate and timely information aligned with the city's dynamic curb management strategy, contributing to improved traffic flow and compliance.

3.3 Bluetooth-Based Entry Validation:

To overcome the limitations of Global Positioning System (GPS)-based geofencing, CurbCommand ITS proposes the deployment of BLE beacons at the entrances of the designated rideshare pickup and drop-off lots, specifically Lot N. These beacons will serve

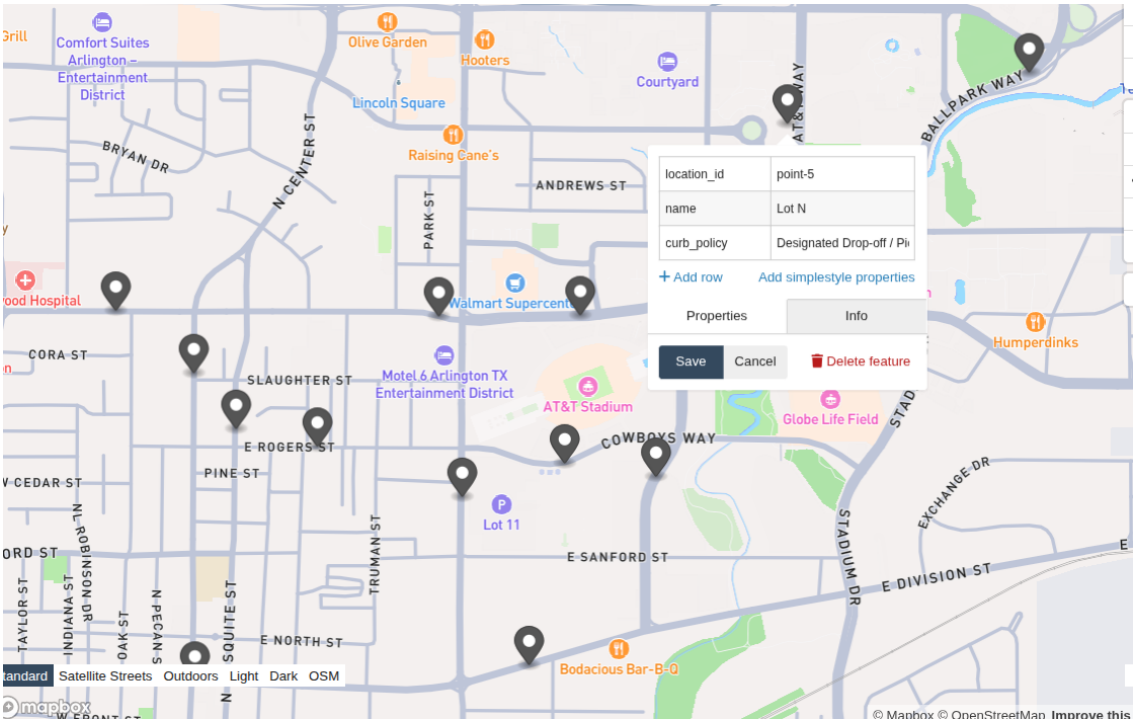

Figure 4: Map visualization of designated and prohibted rideshare curb policy points around AT&T Stadium, highlighting Lot N as the sole authorized drop-off and pick-up zone.

as highly accurate checkpoints to verify that rideshare vehicles have physically entered a permitted area before a pickup or drop-off can be completed. This approach offers a significant advantage in terms of accuracy, providing sub-meter level precision, which effectively addresses the problem of geolocation drift that plagues traditional GPS-based systems. The use of BLE for location validation is a key innovation that directly tackles the issue of imprecise GPS data, a significant limitation of conventional geofencing methods Chen, Lin, and Lin (2019). This enhanced accuracy leads to more reliable enforcement of the designated zones. The requirement for physical entry into the designated lot before the TNC apps allow trip completion introduces a robust mechanism for ensuring compliance and preventing unauthorized drop-offs or pick-ups outside the permitted areas.

3.4 Real-Time Operational Dashboard:

City of Dallas Traffic Management Center operators will have access to an integrated dashboard that provides a comprehensive real-time view of the system's performance. This dashboard will aggregate data from various sources, including the BLE beacon system (lot occupancy and queue status) and general traffic congestion levels in the vicinity of the stadium. This centralized view will enable operators to monitor the overall situation and make informed decisions in real-time. The dashboard will also provide the capability for operators to manually override curb rules if necessary (e.g., in case of unforeseen circumstances) or even open overflow parking lots if the pri-

mary designated lots reach capacity. The real-time operational dashboard provides crucial situational awareness for traffic management personnel, empowering them to proactively intervene and make necessary adjustments to optimize the system's performance. The ability for manual overrides offers a critical layer of flexibility to address unexpected situations or exceptions that the automated system might not be able to handle effectively on its own.

4 Stakeholders

The stakeholders identified that may benefit from or be affected by the proposed CurbCommand ITS solution include, but are not limited to, the following:

- **General Public:** This includes local residents, fans, and the general traveling public on adjacent roadways.
- **Dallas Area Rapid Transit (DART) and Trinity Metro:** Regional transit agencies responsible for bus and shuttle services in the Dallas-Fort Worth metropolitan area.
- **Texas Department of Transportation (TxDOT)** and **North Central Texas Council of Governments (NCTCOG):** State and regional transportation agencies overseeing infrastructure planning, mobility, and safety coordination.
- **City of Dallas Department of Transportation (Dallas DOT):** The authority responsible for traffic management, curb regulation, and transportation system oversight.
- **Transportation Network Companies** such as Uber and Lyft: Private sector mobility providers operating app-based rideshare services around the Stadium area.

5 Architectures

5.1 Physical architecture

The physical architecture of the CurbCommand ITS comprises location aware hardware components deployed at key operational points to enable real-time enforcement and coordination of curbside activities. It leverages BLE beacons and mobile devices to manage rideshare traffic with high spatial precision at Lot N near AT&T Stadium as shown in Fig 3.

BLE beacons are fixed along the perimeter of Lot N to enforce geo-precise entry validation. Operating in passive mode, they continuously emit UUIDs detectable by nearby devices, achieving sub-meter accuracy which is a a major advantage over GPS in dense congested environments. These beacons define a digitally enforceable perimeter for

curbside compliance, ensuring only authorized TNC vehicles complete pickups within Lot N.

Driver side smartphones detect BLE signals upon entering Lot N, calculate RSSI for proximity, and transmit arrival data to the backend. These devices also receive dynamic routing from Waze for Cities, ensuring curb rule compliance. Each mobile unit acts as both a proximity validator and navigation interface, supporting real-time enforcement and congestion-aware access to the zone.

Then fans use smartphones to request and track rides, aligning arrival with authorized pickup points in Lot N.

5.2 Functional architecture

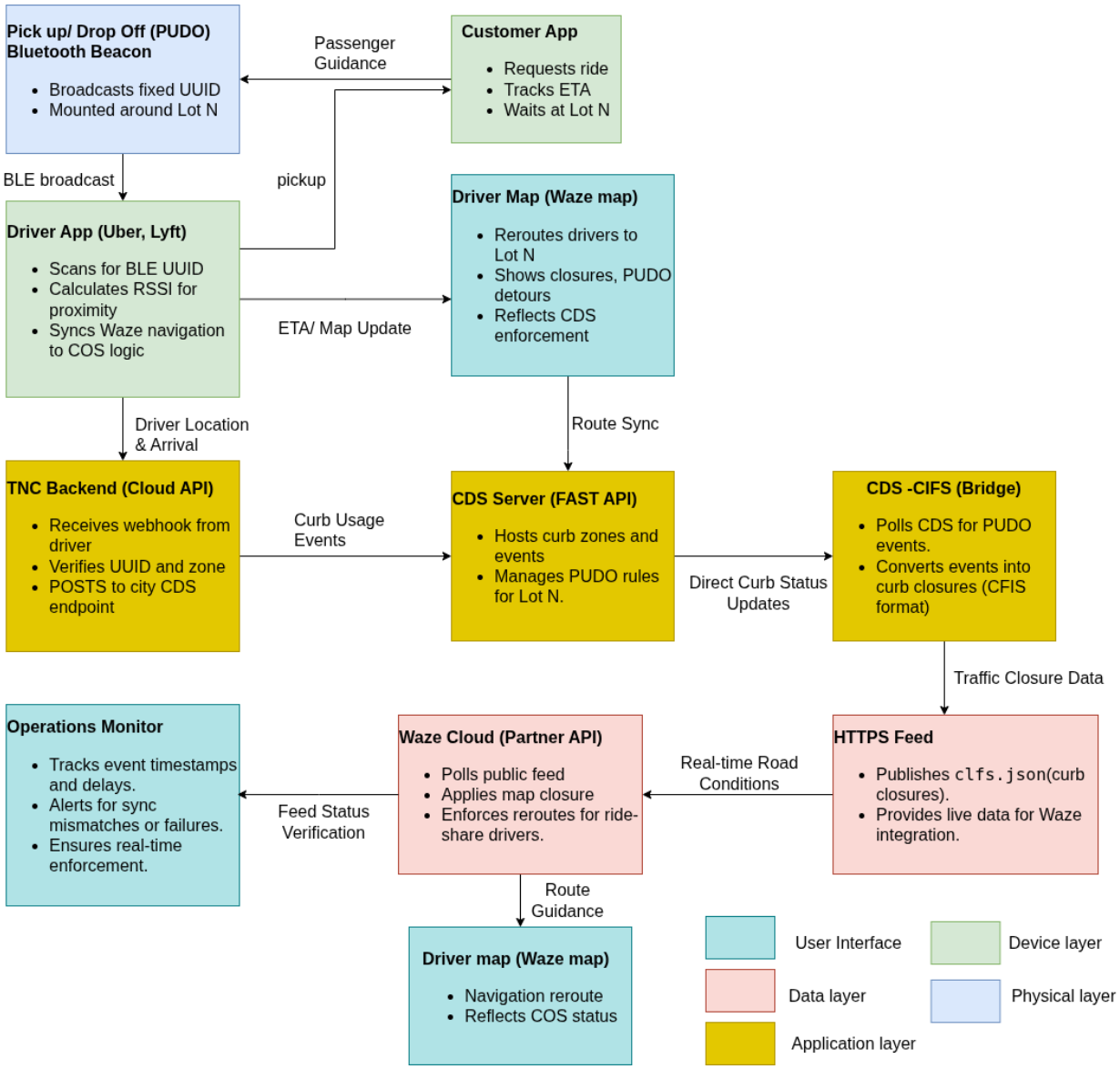

Figure 5: Functional architecture of our proposed CurbCommand ITS

The functional architecture shown in 5 includes a BLE beacon infrastructure, which passively emits Universally Unique Identifiers. (UUIDs) detectable by rideshare driver applications as vehicles enter the geofenced pickup zone. Upon signal acquisition, the driver app calculates proximity using RSSI and transmits an arrival event to the TNC backend via a webhook endpoint. This backend component validates the beacon ID and driver location, formats the event into a CDS compliant JSON structure, and relays it to the city's CDS server.

The CDS server acts as a centralized functional module that stores, validates, and manages curb usage events and zone rules specific to Lot N. These events are periodically retrieved by the CDS–CIFS(Curb Interface Format Specification) bridge, which translates them into the CIFS format for downstream consumption. It also enforces dynamic curb regulations by publishing these events as curb closures. This standardized information is published through an HTTPS feed, where it becomes accessible to the third party systems - Waze Cloud via a public API.

Once ingested, Waze Cloud interprets this real time curb data to implement map-based modifications, including road closures and rerouting strategies that redirect TNC drivers to Lot N. These changes are reflected instantly on the driver's navigation interface (Driver Map), ensuring compliance with active curb policies. Simultaneously, the system's operational integrity is maintained through a dedicated monitoring module that tracks synchronization delays, mismatch alerts, and enforcement efficacy across the architecture. On the user end, the Customer App receives trip updates, guiding fans toward the designated pickup area and ensuring alignment between curbside demand and operational logistics.

6 Impact of CurbCommand ITS

The implementation of the CurbCommand ITS is expected to yield broad, multi dimensional benefits across stakeholder groups by improving how curbside operations are managed during large-scale events. Through a combination of real-time curb rule enforcement, location-based entry validation, and dynamic routing, the system introduces functional efficiencies and safety improvements in and around Lot N at AT&T Stadium. These impacts can be categorized as follows:

Safety Impacts

- Reduces pedestrian-vehicle conflict by routing rideshare activity to designated zones Virginia Tech Transportation Institute (2022).
- Minimizes double parking and random curbside stops near crosswalks and high foot-traffic areasRanjbari, Machado-León, and Goodchild (2020).
- Enhances safety for event attendees, residents, and road users by maintaining clearer separation between pedestrians and vehicles.

Operational Impacts

- Enables automated enforcement of curb usage through BLE-based validation and real-time dashboards Nashville Department of Transportation (2022).
- Decreases curbside dwell times by directing rideshare vehicles only to verified zones Machado-León, MacKenzie, and Goodchild (2023).
- Improves the reliability of transit operations by reducing curb lane obstructions.

Mobility Impacts

- Reduces congestion on arterial roadways by redirecting rideshare traffic to Lot N.
- Improves pickup and drop-off efficiency, accelerating trip turnover.
- Enhances routing reliability through Waze integration and real-time updates Bradley (2015).
- Supports consistent transit headways and multimodal accessibility.

Economic Impacts

- Reduces economic losses caused by traffic delays and illegal parking.
- Lowers enforcement and compliance costs for authorities.
- Uses existing infrastructure, minimizing capital expenditure and enabling cost-effective deployment Goodchild, MacKenzie, Ranjbari, Machado, and Chiara (2019).

Environmental Benefits

- Reduces vehicle idling and circling which lowers localized emissions.

7 Conclusion

This document proposes CurbCommand ITS to manage drop-off and pickup locations for rideshare services during peak traffic times at AT&T Stadium in Arlington. The system utilizes the nationally recognized CDS, location-accurate BLE beacon infrastructure, and integrates with real-time routing platforms like Waze. This integration helps ensure consistent enforcement of curb regulations, enhances rideshare coordination, and improves pedestrian and traffic safety around the stadium.

CurbCommand ITS offers a scalable, cost-effective framework for transportation agencies, enabling real-time situational awareness, centralized rule management, and flexible override capabilities. It minimizes the need for expensive infrastructure upgrades by using existing digital assets and promotes interoperability among public and private mobility providers. The system also contributes to reduced congestion, emissions, and

enforcement costs all of which align with broader Department of Transportation goals for sustainable and efficient urban mobility.

Beyond the World Cup, this solution serves as a pilot for long-term curbside policy modernization. It provides a replicable model for other cities preparing major events to implement adaptive curb management in response to evolving urban mobility demands.

References

Bradley, R. (2015, June 2). Waze and the traffic panopticon. *The New Yorker*. Retrieved from https://www.newyorker.com/business/currency/waze-and-the-traffic-panopticon

Brown, L. (2025). *Dallas leaders raise concerns with 2026 world cup approaching.* Retrieved from https://www.fox4news.com/news/world-cup-2026-dallas-preparation (FOX 4 News)

Chen, H.-T., Lin, P.-Y., & Lin, C.-Y. (2019). A smart roadside parking system using bluetooth low energy beacons. In *Advances in intelligent systems and computing* (pp. 471–480). Springer. Retrieved from https://doi.org/10.1007/978-3-030-15035-8_44

De Alba, A. (2022). *'An absolute nightmare' | Long waits and price surges: Rideshare at AT&T Stadium causing major headaches.* Retrieved from https://www.wfaa.com/article/news/local/rideshare-problems-att-stadium/287-400d7cfe-1efd-46cb-bbc6-de8da072978b (WFAA News)

FIFA. (2025). *Dallas to host nine fifa world cup 26 matches.* Retrieved from https://www.fifa.com/en/tournaments/mens/worldcup/canadamexicousa2026/articles/dallas-stadium-host-nine-world-cup-matches (Accessed May 31, 2025)

Goodchild, A., MacKenzie, D., Ranjbari, A., Machado, J., & Chiara, G. D. (2019, June). *Curb allocation change project: Final report* (Tech. Rep.). Urban Freight Lab, University of Washington, Sustainable Transportation Lab. Retrieved from https://www.urbanfreightlab.com/wp-content/uploads/2023/04/Curb-Allocation-Change-Project-UWUrbanFreightLab.pdf

Lab, U. F. (2019a, January). *The final 50 feet of the urban goods delivery system: Tracking curb use in seattle* (Tech. Rep.). Supply Chain Transportation and Logistics Center, University of Washington. Retrieved from https://depts.washington.edu/toolkit/sites/default/files/toolkit_downloads/Final-50-Feet-Tracking-Curb-Use-in-Seattle_0.pdf (Sponsored by Seattle Department of Transportation)

Lab, U. F. (2019b). *New research: Study shows promise for curbing ride-hail traffic.* Retrieved from https://urbanfreightlab.com/news_announcements/new-research-study-shows-promise-for-curbing-ride-hail-traffic/ (Accessed May 31, 2025)

Liu, X., Qian, S., Teo, H.-H., & Ma, W. (2024). Estimating and mitigating the congestion effect of curbside pick-ups and drop-offs: A causal inference approach. *Transportation Science*, *58*(2), 355–376.

Machado-León, J. L., MacKenzie, D., & Goodchild, A. (2023). An empirical analysis of passenger vehicle dwell time and curb management strategies for ride-hailing pick-up/drop-off operations. *Transportation*. Retrieved from https://doi.org/10.1007/s11116-023-10380-6

Nashville Department of Transportation. (2022). *Best practices: Curb management.* Retrieved from https://www.nashville.gov/sites/default/files/2023-01/BestPractices_CurbManagement_20220916_FINAL.pdf

Ranjbari, A., Machado-León, J. L., & Goodchild, A. (2020). Testing curbside management strategies to mitigate the impacts of ridesourcing services on traffic. *Transportation Research Record: Journal of the Transportation Research Board*, *2675*(2), 10–22. Retrieved from https://doi.org/10.1177/0361198120957314 doi: 10.1177/0361198120957314

Richie, S. (2023). *why is there no mass public transportation to get to the world series in arlington.* Retrieved from https://www.dallasnews.com/news/transportation/2023/10/31/why-is-there-no-mass-public-transportation-to-get-to-the-world-series-in-arlington/ (Accessed May 31, 2025)

Sadek, S. (2024). *Att stadium sidelined for final world cup match but scores most games.* Retrieved from https://fortworthreport.org/2024/02/04/att-stadium-falls-short-of-scoring-world-cup-final/ (Accessed May 31, 2025)

SharedStreets. (2025). *Curblr: An open data specification for curb regulations.* Retrieved from https://curblr.org (Accessed May 31, 2025)

Staff, N., & Yeomans, M. (2024). *'this is a fabulous success,' arlington to host nine world cup matches.* Retrieved from https://www.nbcdfw.com/news/sports/new-york-to-host-2026-world-cup-final-arlington-to-host-nine-matches/3452810/ (Accessed May 31, 2025)

Virginia Tech Transportation Institute. (2022). *Curb management practices and effectiveness in improving safety* (Tech. Rep. No. 05-096). SAFE-D National UTC, Virginia Tech Transportation Institute. Retrieved from https://safed.vtti.vt.edu/sdm_downloads/05-096-curb-management-practices-and-effectiveness-in-improving-safety/

Waze. (2025). *Navigating challenges: How waze improves traffic management and safety.* Retrieved from https://www.waze.com/wazeforcities/casestudies/how-waze-improves-traffic-management-safety (Accessed May 31, 2025)