***Functional Requirements***

***User Authentication and Authorization***

1. The system must allow \*Super Admin, \*\*Admin, \*\*Driver, \*\*Conductor, and \**Student* to log in using valid credentials.
2. The system must provide a *sign-up module* for Super Admin to create Child Admin accounts and assign permissions.
3. The system must verify user roles to grant access to specific modules.

***Bus and Route Management***

1. The Admin must be able to add, update, or delete bus details.
2. The Admin must define territories or routes for buses.
3. The Driver must be able to record and update routes for specific buses.
4. The Admin must view the list of available buses and their assigned routes.

***Journey Management***

1. The Driver must be able to initiate or end a journey.
2. The system must track the live location of buses during an active journey.
3. The Driver must authenticate student cards when they board the bus.
4. The system must record journey data, including the bus number, route taken, boarded students, and the driver responsible.
5. Admin and Students must have access to the bus’s live location.
6. Admin must be able to view complete journey history for all buses.

***Bus Card Management***

1. Admin must assign bus cards to Students.
2. Admin must be able to revoke or enable student bus cards.
3. The system must verify student cards during boarding.

***Session and Student Management***

1. Admin must create or end sessions and set their expiry dates.
2. The system must disable student cards automatically if the session expires or is deleted.
3. The system must generate app credentials for Students when they are added to the system.
4. Admin must be able to manage student data (add, update, delete).

***Bus Staff Management***

1. Admin must be able to add and manage Drivers and Conductors.
2. The system must generate app credentials for Drivers and Conductors upon registration.

***Complaint Management***

1. Students and Drivers must be able to submit complaints through their apps.
2. Admin must have a module to view, address, and resolve complaints.
3. The system must maintain a record of all complaints and their statuses.

***Announcement Management***

1. Admin must be able to create and manage announcements.
2. The system must deliver announcements as notifications to Drivers and Students through their apps.

***Notification and Alerts***

1. The system must send notifications to Students and Drivers for announcements, route updates, or other relevant information.
2. The system must alert Admin if a bus deviates from its assigned route or goes out of its territory.

***Live Location Tracking***

1. The system must track the real-time location of buses during active journeys.
2. Admin and Students must access live bus locations via their apps.
3. The system must record location data for journey history and analysis.

***Data Management***

1. The system must store and manage records for buses, routes, journeys, users, and complaints.
2. The system must maintain logs of all system actions for accountability.

***Non-Functional Requirements***

***Performance***

1. The system must update live bus locations every 5 seconds.
2. ID card verification must be processed within 2 seconds.
3. Notifications must be delivered within 1 second of announcement creation.

***Scalability***

1. The system must support up to 10,000 users simultaneously.
2. The system must accommodate 1,000 buses and their associated journeys without performance degradation.

***Reliability***

1. The system must maintain 99.9% uptime to ensure real-time tracking availability.
2. The system must recover from failures within 10 seconds.

***Security***

1. All user data and credentials must be encrypted during transmission and storage.
2. The system must implement role-based access controls (RBAC) to restrict unauthorized access.
3. The system must log failed login attempts and lock accounts after 5 invalid attempts.

***Usability***

1. The system must provide a mobile-friendly interface for Drivers, Students, and Conductors.
2. Admin must have an intuitive web interface for managing buses, routes, and announcements.

***Compatibility***

1. The system must work on Android, iOS, and major web browsers.
2. The system must integrate with GPS and NFC systems for tracking and card authentication.

***Maintainability***

1. The system must have modular architecture to support easy updates and feature additions.
2. System logs must be accessible for debugging and monitoring.

***Availability***

1. The system must be available 24/7 for Students and Admin.
2. The system must handle offline scenarios and sync data when back online.

***Efficiency***

1. The system must consume minimal battery and data on user devices.
2. Server resource utilization must remain below 75% under peak load conditions.

***Compliance***

1. The system must comply with data protection regulations such as GDPR or local equivalents.

***Scalability and Extensibility***

1. The system must allow integration of additional modules, such as predictive route analytics or advanced reporting.