



Case Study

Smart Bus Operations

System Development

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PROJECT OVERVIEW

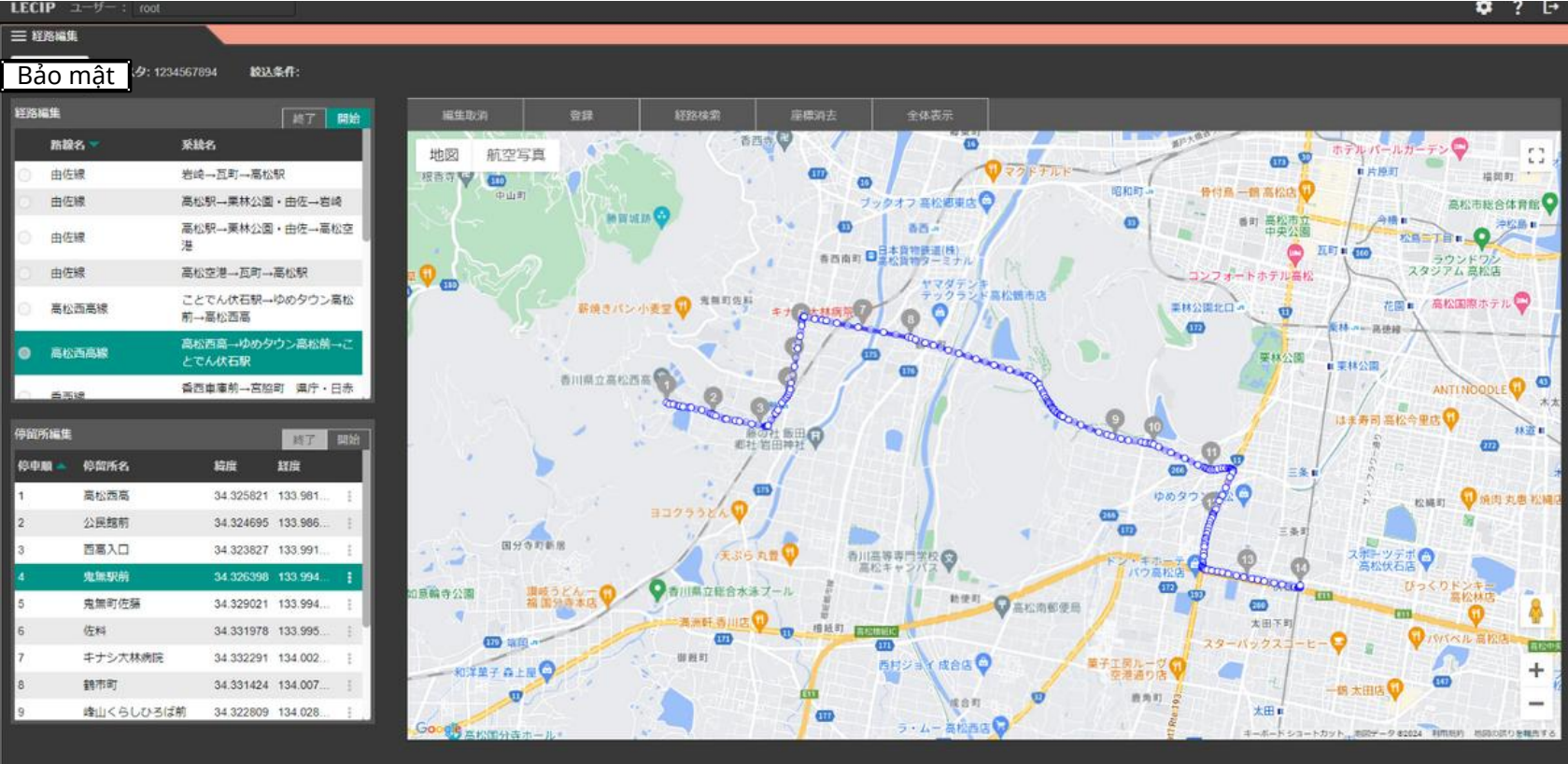


PROJECT OVERVIEW

Luvina Software partnered with a Japanese client to design and develop a **smart bus monitoring and operations system** for small-scale transportation companies. The solution includes both a **PC-based management portal** and a **mobile web application** for end users. Alongside development, Luvina also provided expert consulting on **system architecture and infrastructure**, proposing a **cost-effective, scalable serverless and microservices-based model**.

This helped the client significantly reduce operational costs and remove reliance on expensive, off-the-shelf products, improving profitability while maintaining system reliability.

- **Location:** Japan
- **Industry:** Transportation
- **Focus Area:** Bus Operations
- **Duration:** 08/2023 ~ 11/2023
- **Size:** 30.9 MM
- **Service Offered:** End-to-end web app and mobile app development



PROJECT OVERVIEW

Client & Objectives

Our client is a local bus operator in Japan, managing fewer than 15 vehicles per month. They sought to build a **dedicated operations management system** tailored to their needs, as existing off-the-shelf services came with **prohibitively high maintenance costs** (USD 100–280/month), making the business unprofitable.

Key Requirements

- A **web-based platform** for managing company, vehicle, route, and schedule data, as well as real-time operational monitoring.
- A **mobile web application** for passengers to search and view bus schedules.
- **Infrastructure consulting** to design a low-cost, scalable backend that suits small-business operations.

Challenges

As a small business with limited budget and resources, the client needed a cost-efficient yet fully functional system; one that delivers enterprise-level capabilities without the burden of complex infrastructure or high monthly fees. They also lacked in-house IT staff, which meant the system had to be easy to maintain and operate without dedicated administrators.

Luvina's Solutions

Luvina delivered a lightweight, scalable system architecture using serverless infrastructure and microservices, enabling the client to:

- Pay only for actual usage (per request/month), eliminating fixed infrastructure costs.
- Avoid hiring system administrators, thanks to automated backend services.
- Easily scale the system as their business grows, with clear and predictable cost structures.
- We also proposed cost-effective GPS tracking by integrating with existing market-available GPS devices, removing the need for expensive in-vehicle hardware.

PROJECT OVERVIEW

Achievements

- **20% reduction** in total system operating costs
- **Average cost per vehicle:** only **USD 10/month**
- **Zero need for IT staff** to manage the system
- **No hardware installation** required on buses, using affordable GPS devices instead
- Flexible and scalable system architecture ready for future growth

FEATURES & USE CASES



KEY FEATURES

Admin (Web Interface): For Transport Operators

Vehicle Operations Monitoring

- Real-time vehicle list and map view
- Detailed view of each vehicle and bus stop

Performance Reports

- Export daily and monthly operation summaries Master Data Management
- Register and manage core data (vehicles, routes, stops)
- Configure dispatch schedules
- Edit routes, vehicles, and onboard devices

User & Account Management

- Manage system users and access rights
- Dedicated admin access

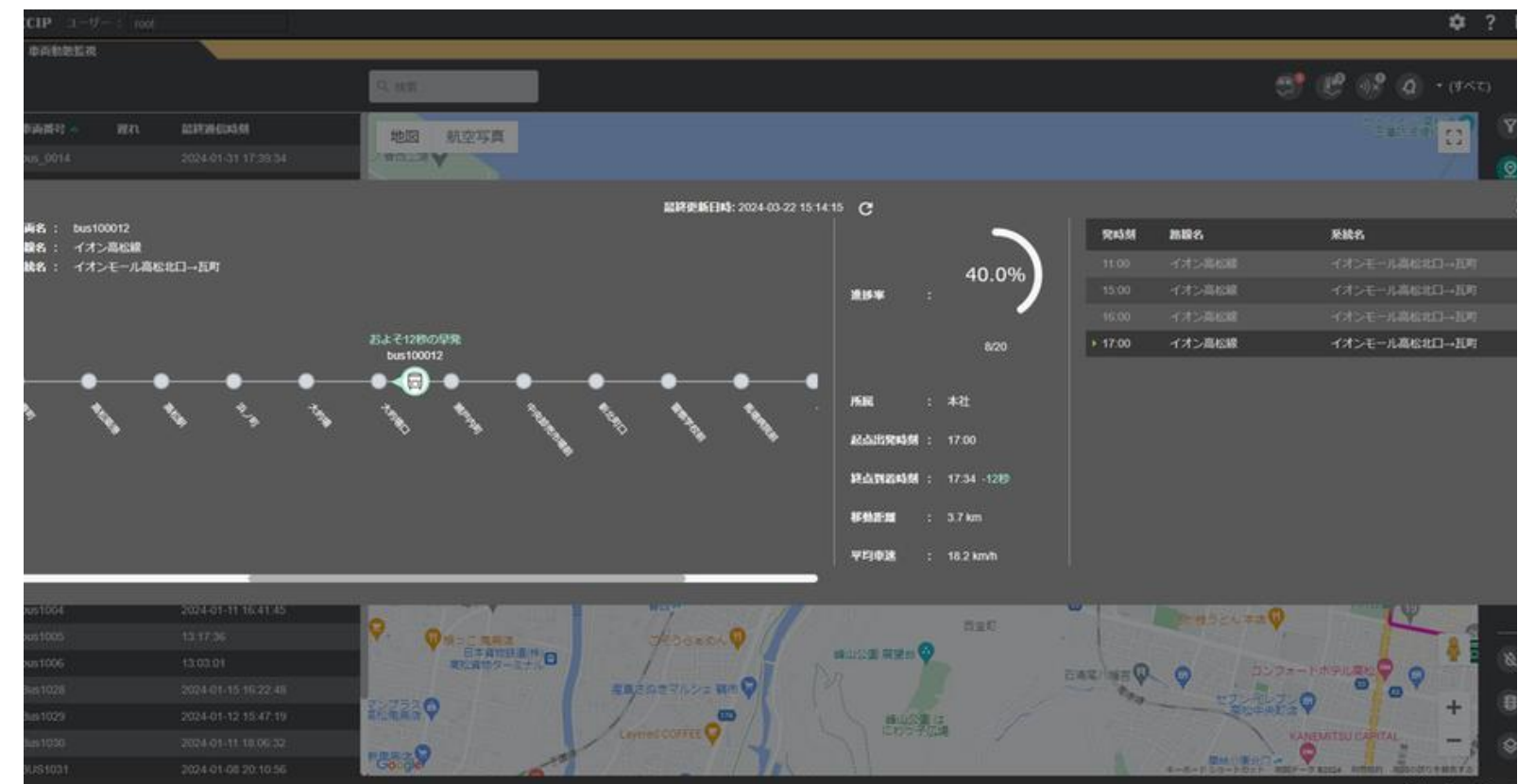
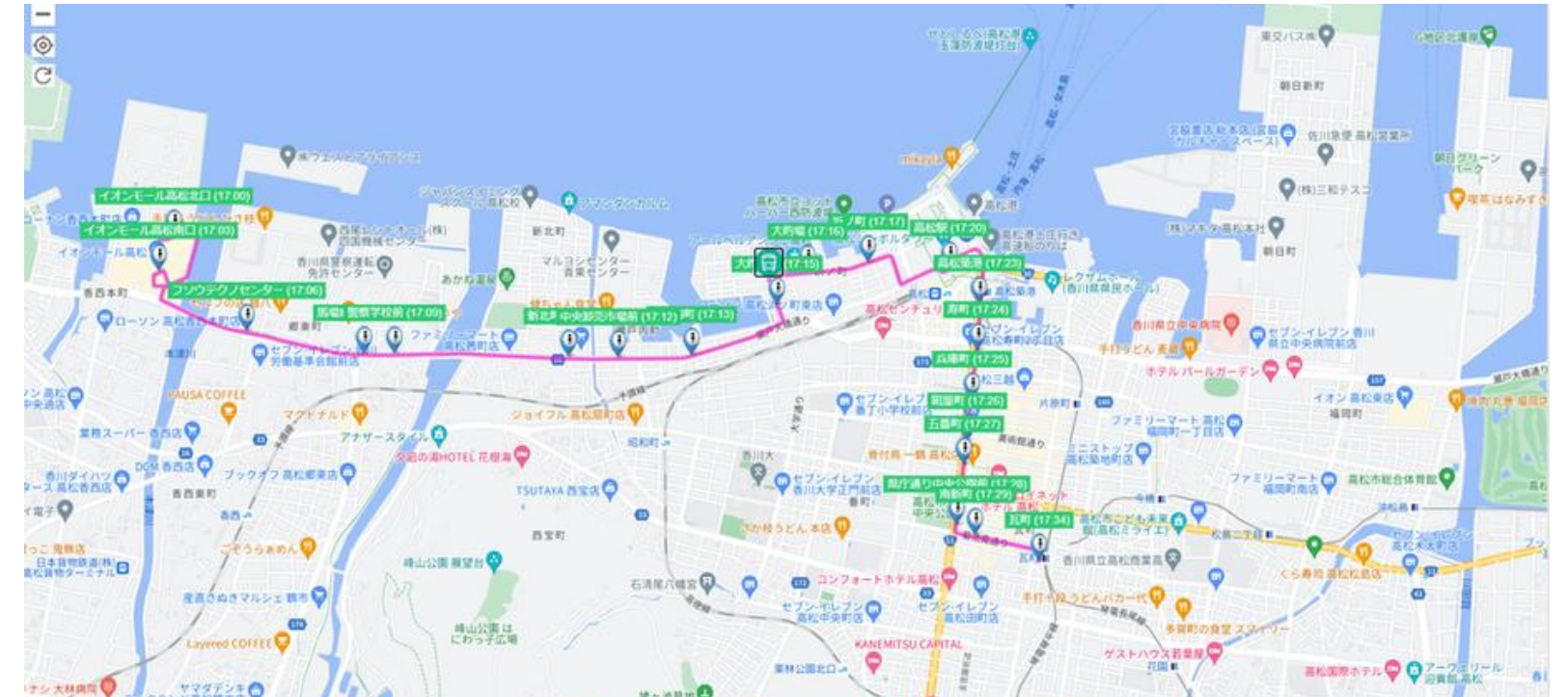
Passenger Interface (Mobile Web App)

Bus Route Tracking

- Real-time route and location update
- Notifications and service policy information
- Search by location, map, or ride history
- Select preferred language
- View detailed announcements

Bus Search Functions

User Personalization



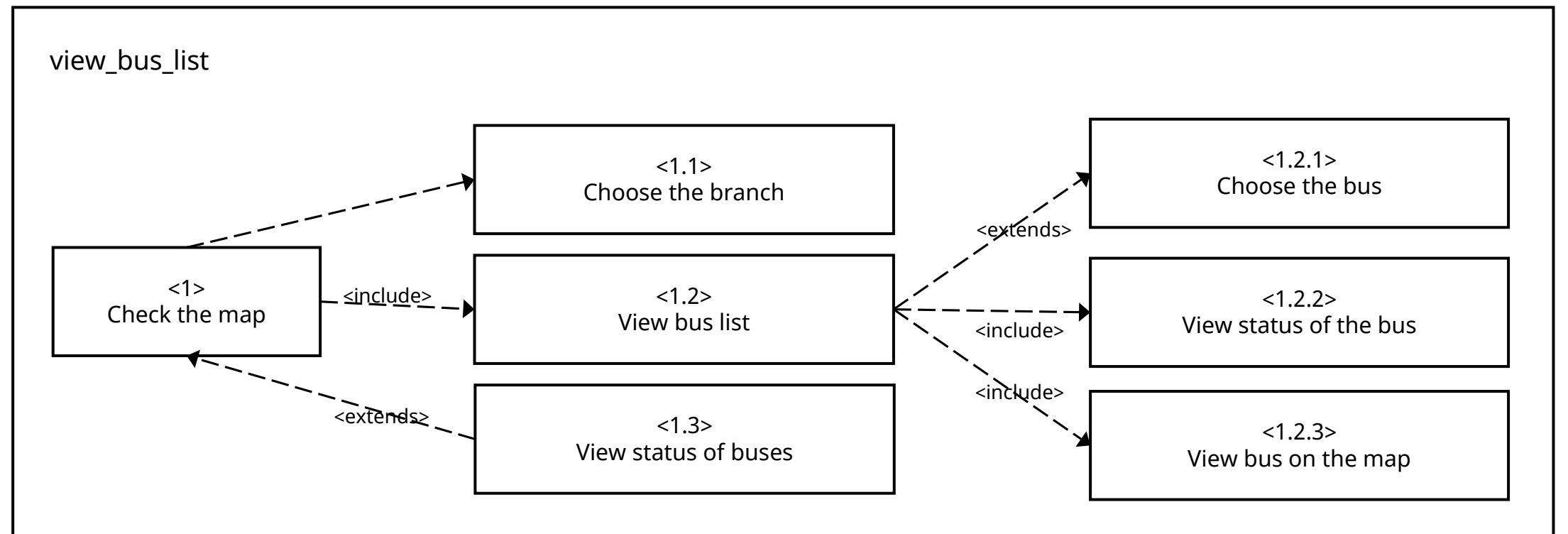
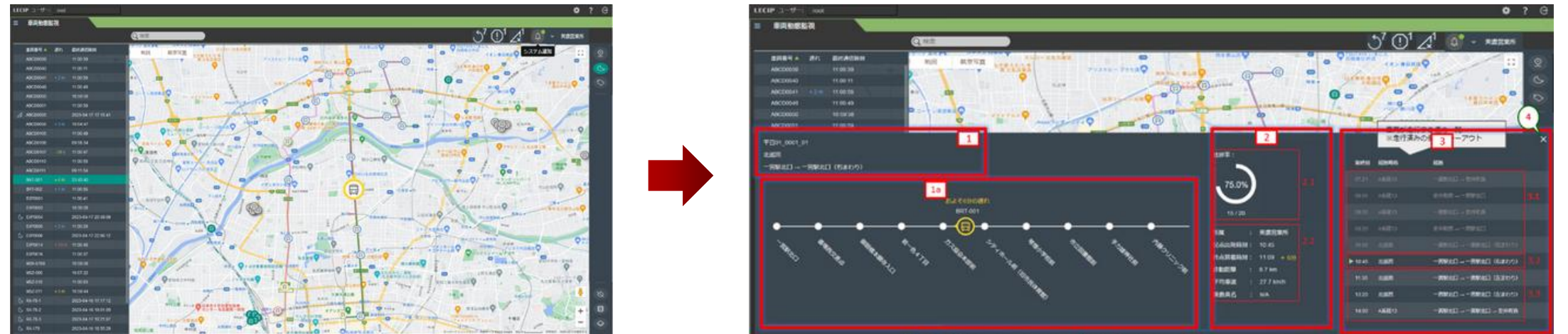
USER CASE: Real-time Vehicle Monitoring

Bus operations staff can log into the system to:

- **Monitor active vehicles** from a real-time vehicle list
- **Filter by office/branch** to view localized vehicle data
- **View vehicle status notifications**, such as:
 - Early departure
 - Late departure
 - Unexpected stops
 - On-time tracking
- **Track vehicle positions** on an interactive map
- **Search for specific vehicles** using keywords or filters

Supervisors can drill down into each vehicle to:

- See the **current route** being operated
- Track the **real-time progress** along that route
- View the **full list of vehicles operating** on the current day



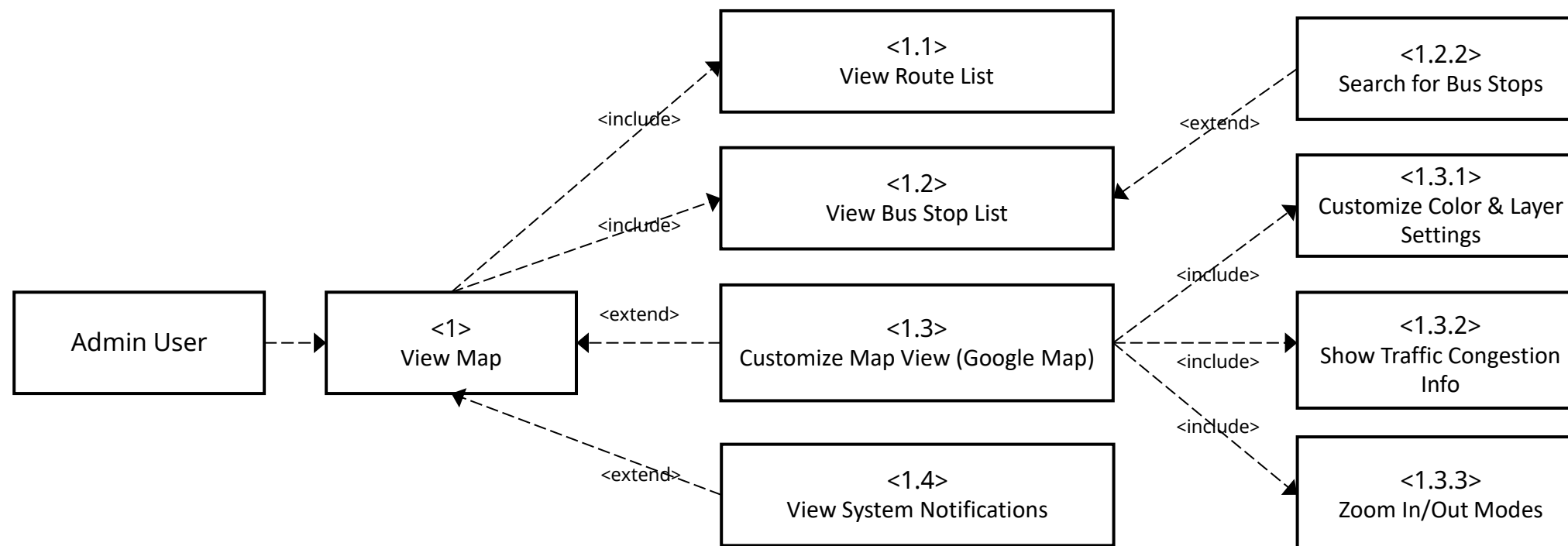
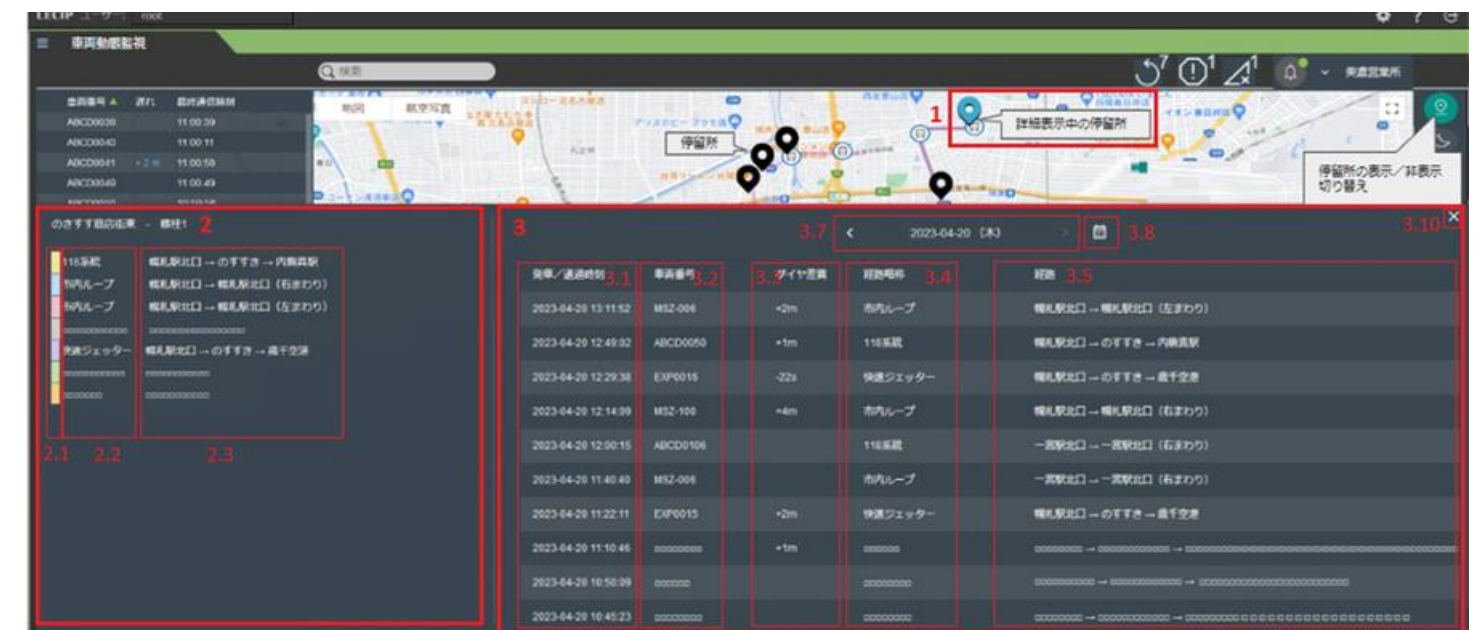
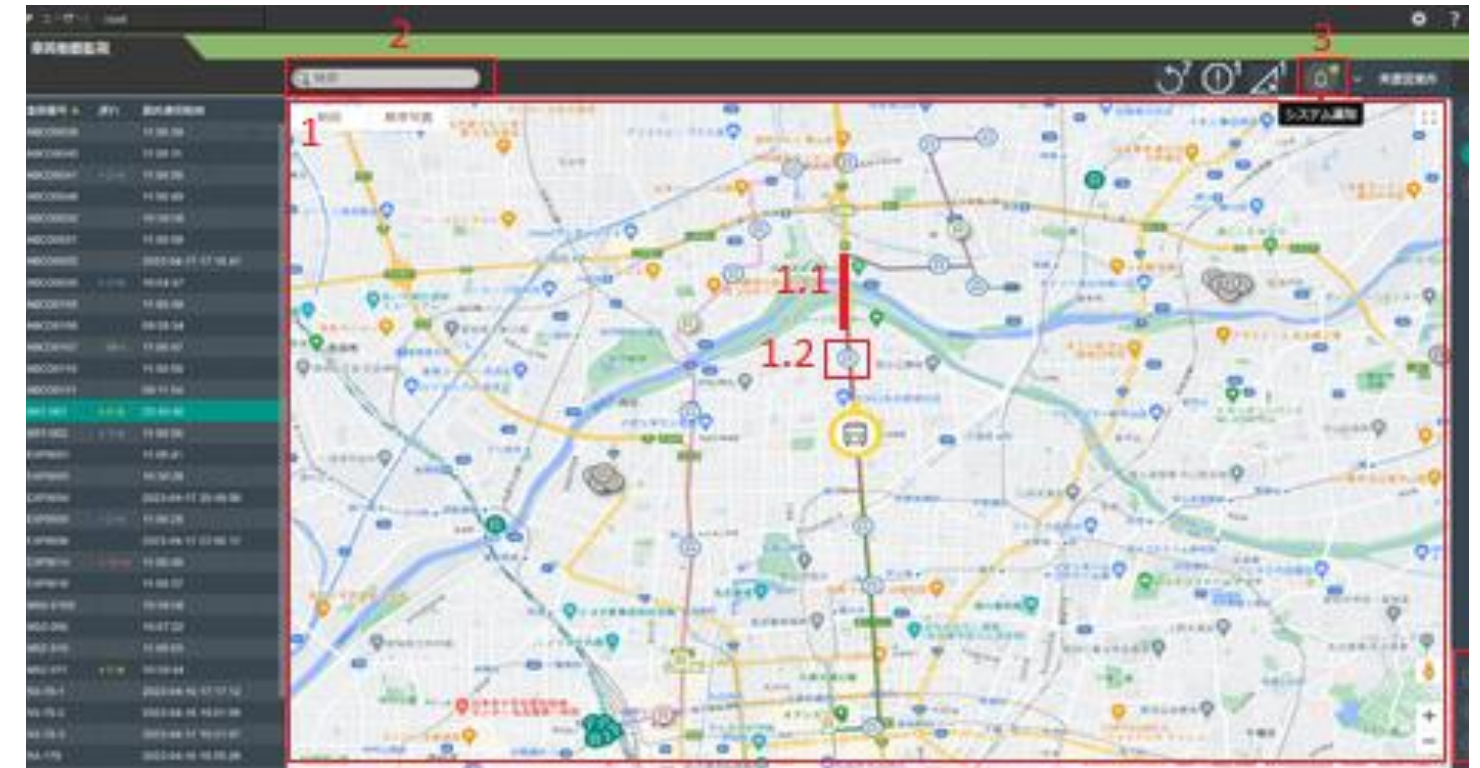
USER CASE: Bus Stop Monitoring

Operations staff can log into the system to monitor and manage **bus stops** effectively:

- **View list of all routes**
- **View and manage list of bus stops**
- **Customize and edit bus routes directly on the map**
- **Receive and view system notifications** related to stops and routes

From each stop, staff can:

- **View all routes passing through the stop**
- **Access historical data** of buses that passed through
- **Export stop history reports** for operational analysis



USER CASE: Operational History Tracking

The system provides a dedicated screen to **track historical operational data** of buses.

Key Functions:

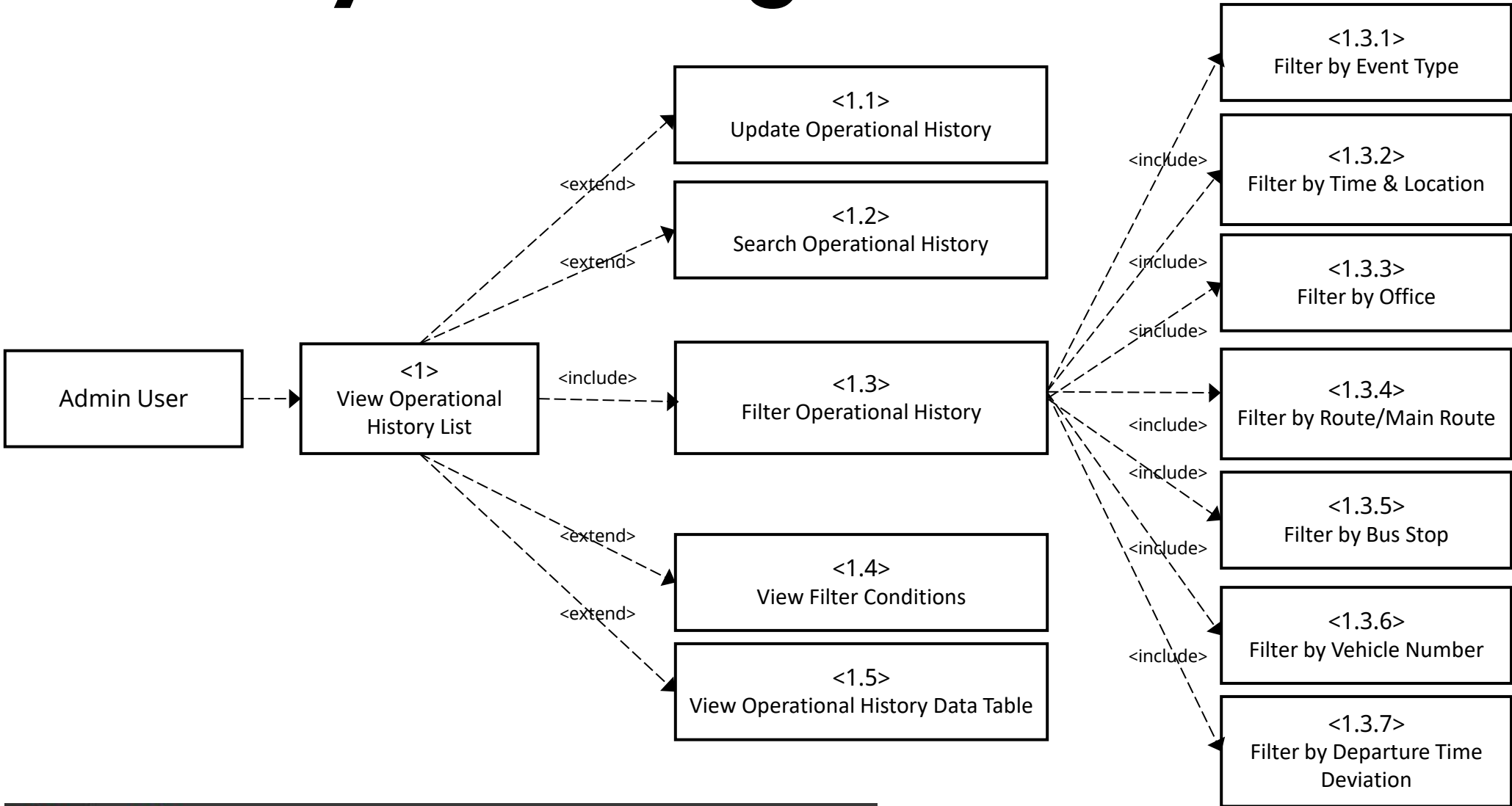
- View operational history of each bus by **office, date, or vehicle ID**
- Search and filter records within the **last 2 weeks** (data is stored in **DynamoDB** with a 14-day retention policy)
- For extended historical access, data is periodically archived to cloud storage

Automated Archival Process:

- Every day at **4:00 AM**, the system automatically:
 - Collects previous day's operational data by office
 - Converts data into **CSV format**
 - Uploads the files to **Amazon S3**

Long-Term Data Access:

- CSV files on **S3** are retained for up to **13 months**
- Admins can retrieve and export historical operational reports from S3 storage as needed



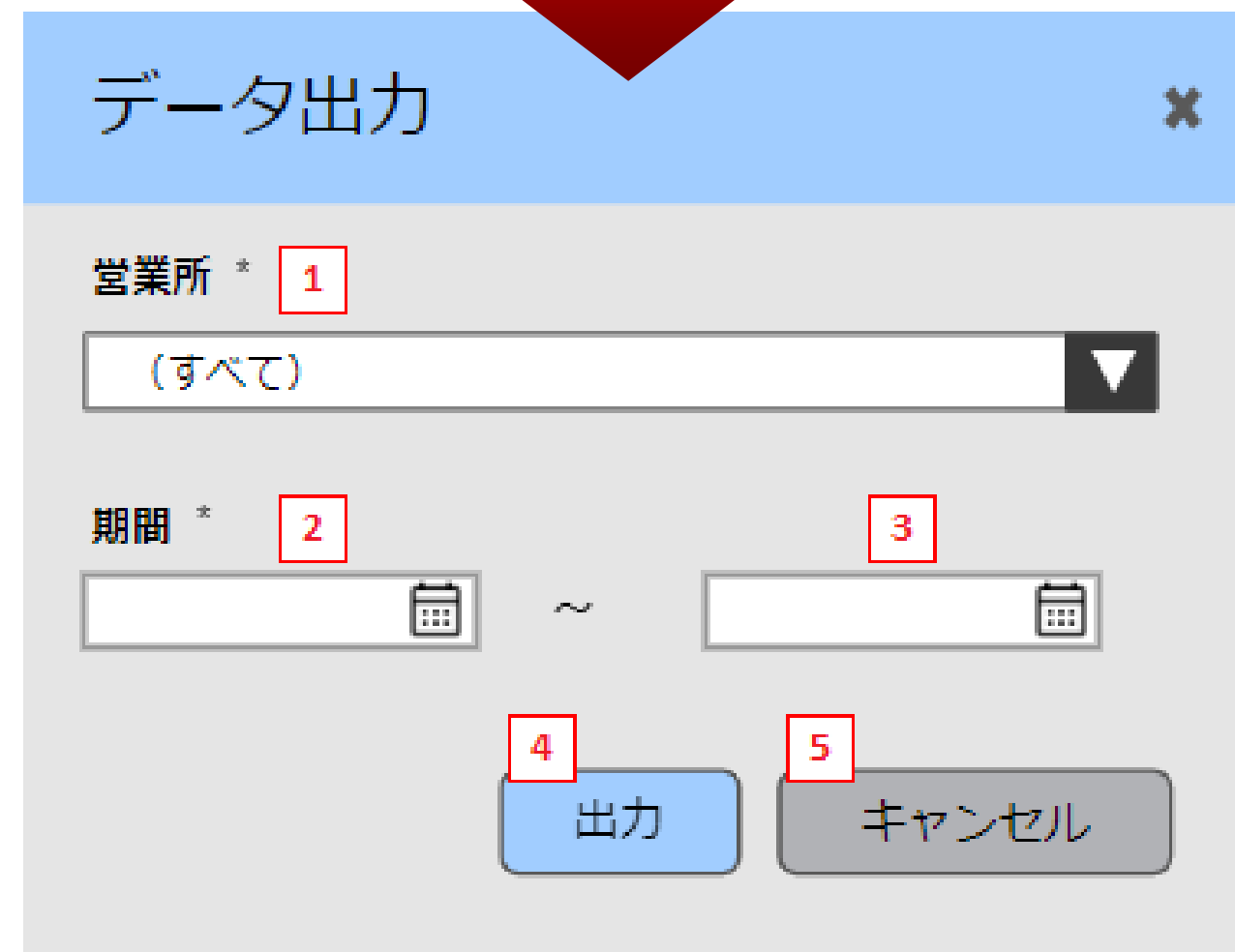
| 履歴番号 | イベント | 出発時刻 | 通過時刻 | 停留所名 | 路線 | 系統 | 遅延 | |
|------|---------|------|-------|---------|---------------|-------------------------|-----------------------|-------------------|
| 1050 | バス停到着 | 9:4 | 9:5 | 34/39 | 由比天降 | 由比線 | 9:8 高松駅→東林公園・由比→岩崎 | 9:9 平日_08時43分_ |
| 1027 | バス停到着 | | 29/36 | 市役所西 | 下笠原線 | 高松駅→高松町 高松・日赤前→高松駅 | | 平日_09時43分_ |
| 1006 | バス停到着 | +2m | 5/33 | 北塚町 | 下笠原線 | 高松駅→昭和町市立図書館→高松駅 | | 平日_09時47分_ |
| 265 | バス停到着 | +6m | 15/39 | 今里文庫前 | レインボ-循環バス 東回り | 高松駅→高松駅(東回り) | | 平日_09時51分_ |
| 1056 | バス停到着 | +7m | 15/26 | ゆめタウン高松 | 東山線 | 高松駅→東林公園 ゆめタウン高松→香川中央病院 | | 平日_09時51分_ |
| 307 | バス停到着 | +1m | 1/22 | ことでん伏石駅 | 伏石駅サンメッセ線 | ことでん伏石駅→サンメッセ香川→ことでん伏石駅 | | 平日_09時55分_ |
| 429 | バス停到着 | +1m | 5/12 | 真立中央病院 | 朝日町線 | 朝日町→朝日センター 真立中央病院→高松駅 | | 平日_09時56分_ |
| 240 | バス停到着 | | 8/33 | 下笠原支所前 | 下笠原線 | 高松駅→昭和町市立図書館→高松駅 | | 平日_10時00分_ |
| 1006 | 送りボタン押下 | | | | 下笠原線 | 高松駅→昭和町市立図書館→高松駅 | | 平日_10時11分_ |
| 1006 | バス停到着 | +5m | 19/39 | 新川 | 東山線 | 高松駅→国際ホテル→東山線 | | 平日_10時20分_ |
| 1070 | バス停到着 | | 15/34 | 西石 | 大学病院線 | ことでん高松駅→互町→高松駅 | | 平日_10時21分_ |
| 265 | 乗降終了 | | 15/39 | 今里文庫前 | レインボ-循環バス 東回り | 高松駅→高松駅(東回り) | | 平日_10時30分_ |

USER CASE: Vehicle Dispatch Scheduling

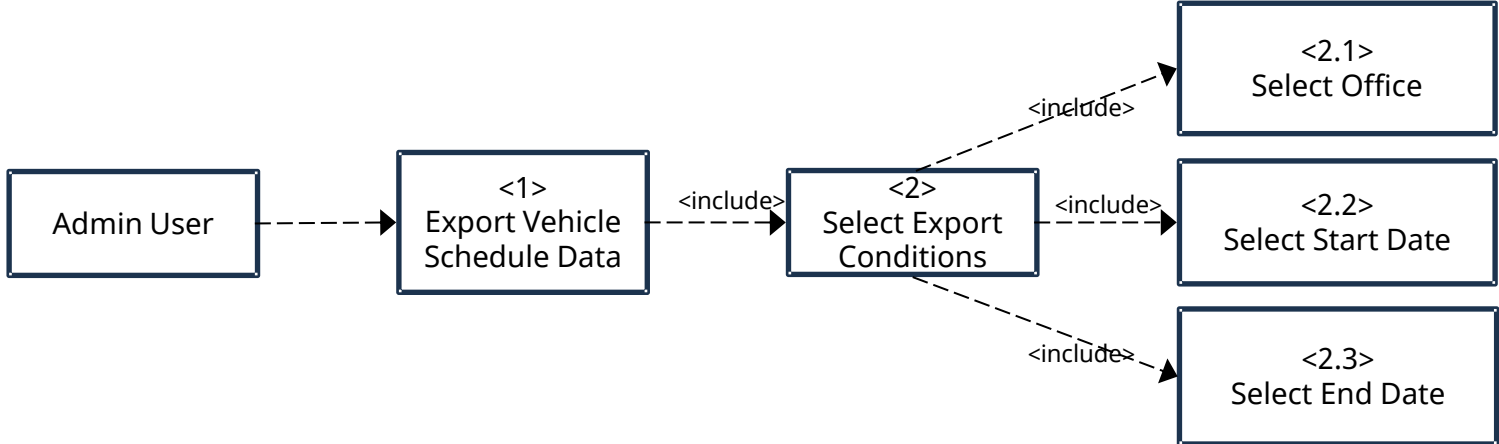
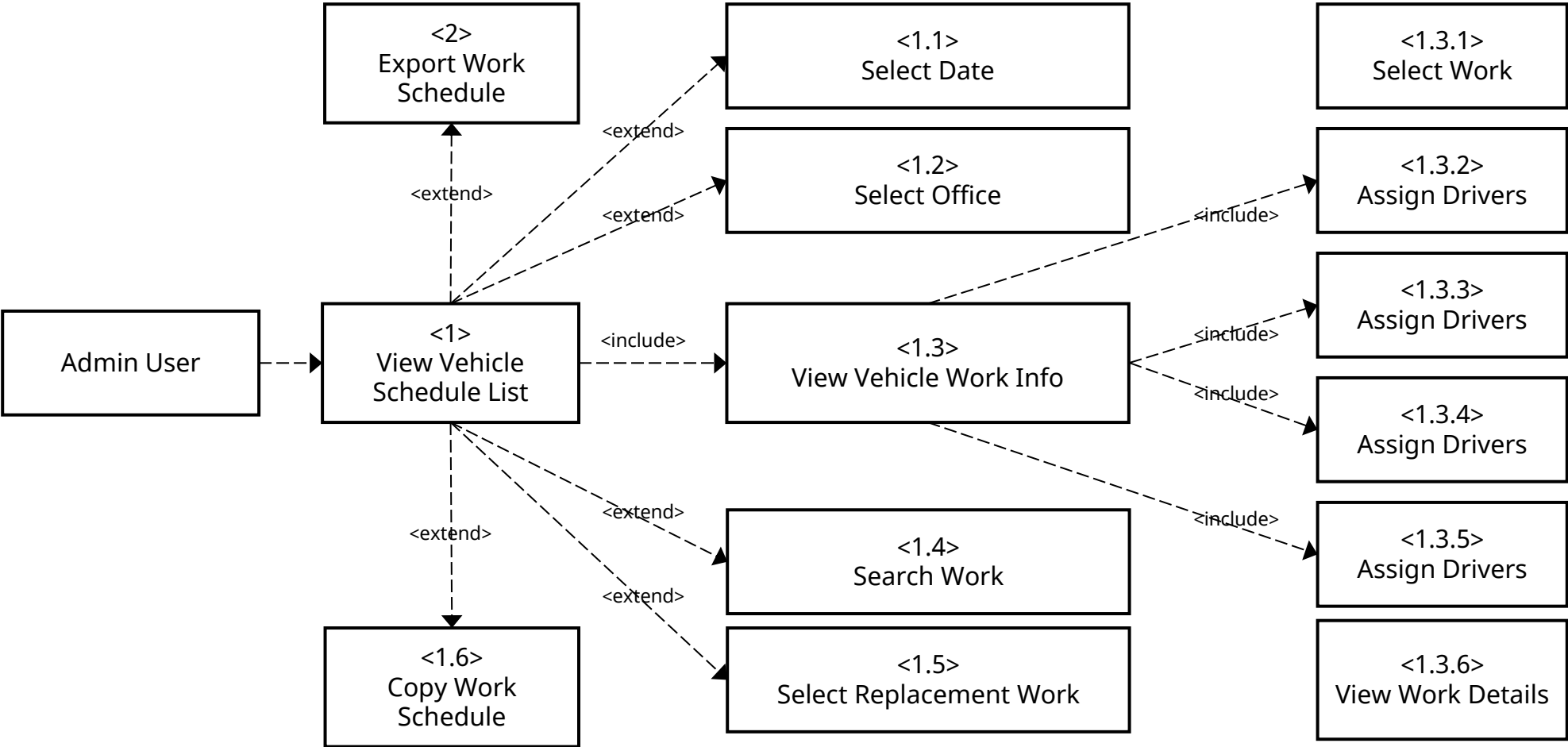
This feature enables administrators to **manage and monitor the dispatch schedules** of all buses.

Key Functions:

- View the full **dispatch schedule list**, including:
 - Assigned drivers
 - Vehicle numbers
 - Office/branch location
 - Assigned work schedules
- Search for specific vehicle operations
- Update or **replace work schedules** for individual vehicles
- View **detailed work assignments**
- Export the complete **vehicle operation schedule** as a CSV file for reporting or backup



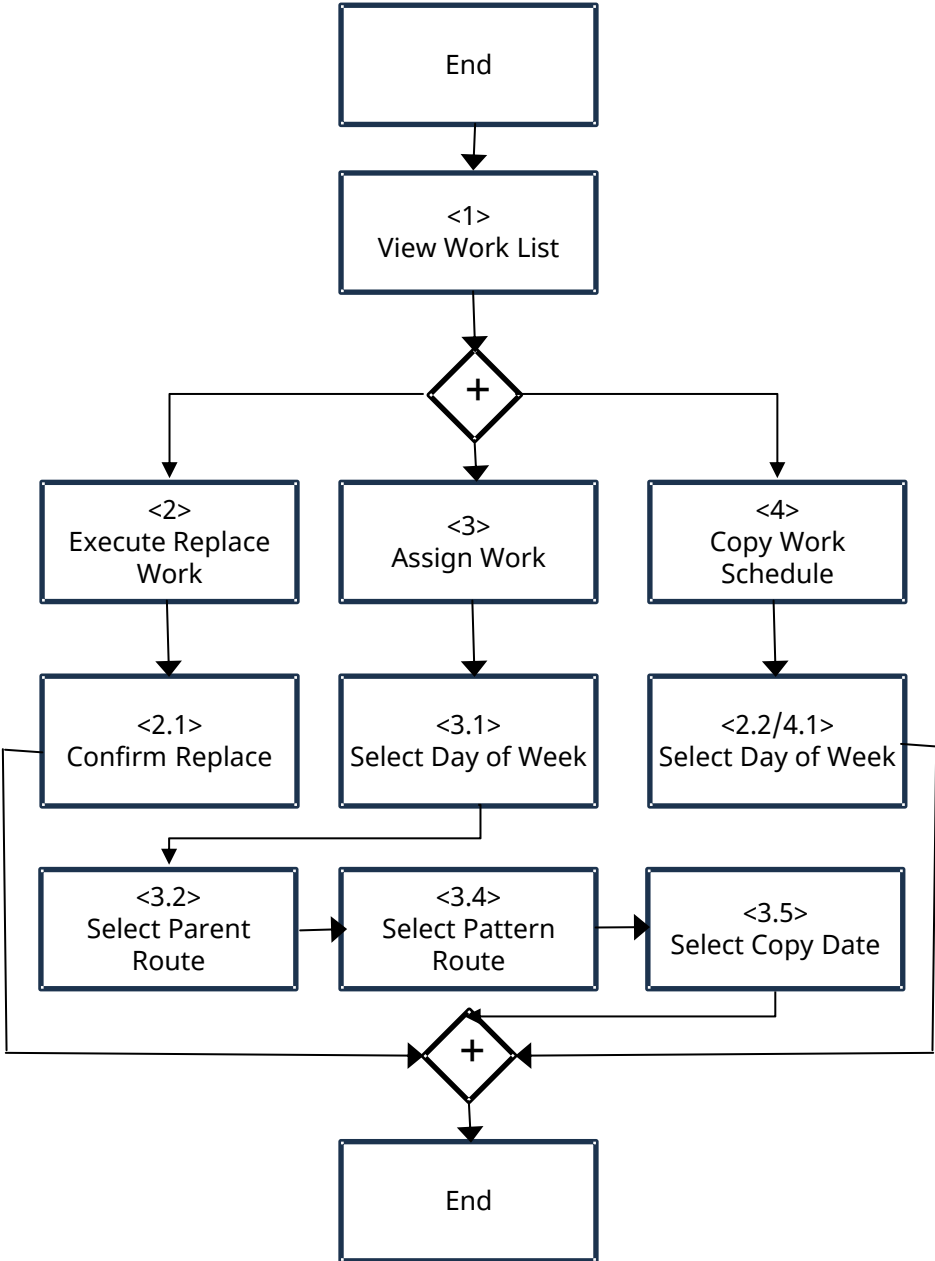
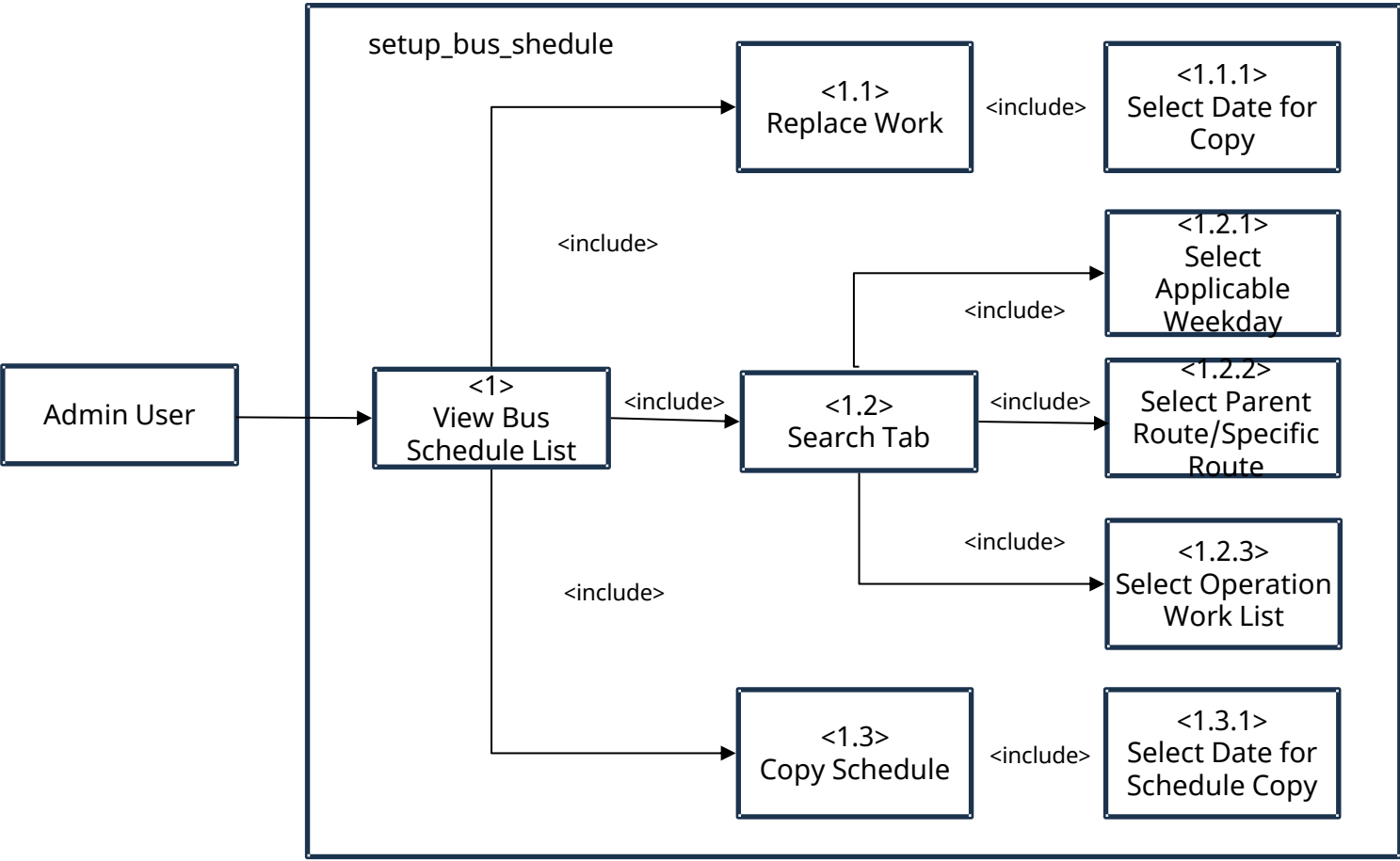
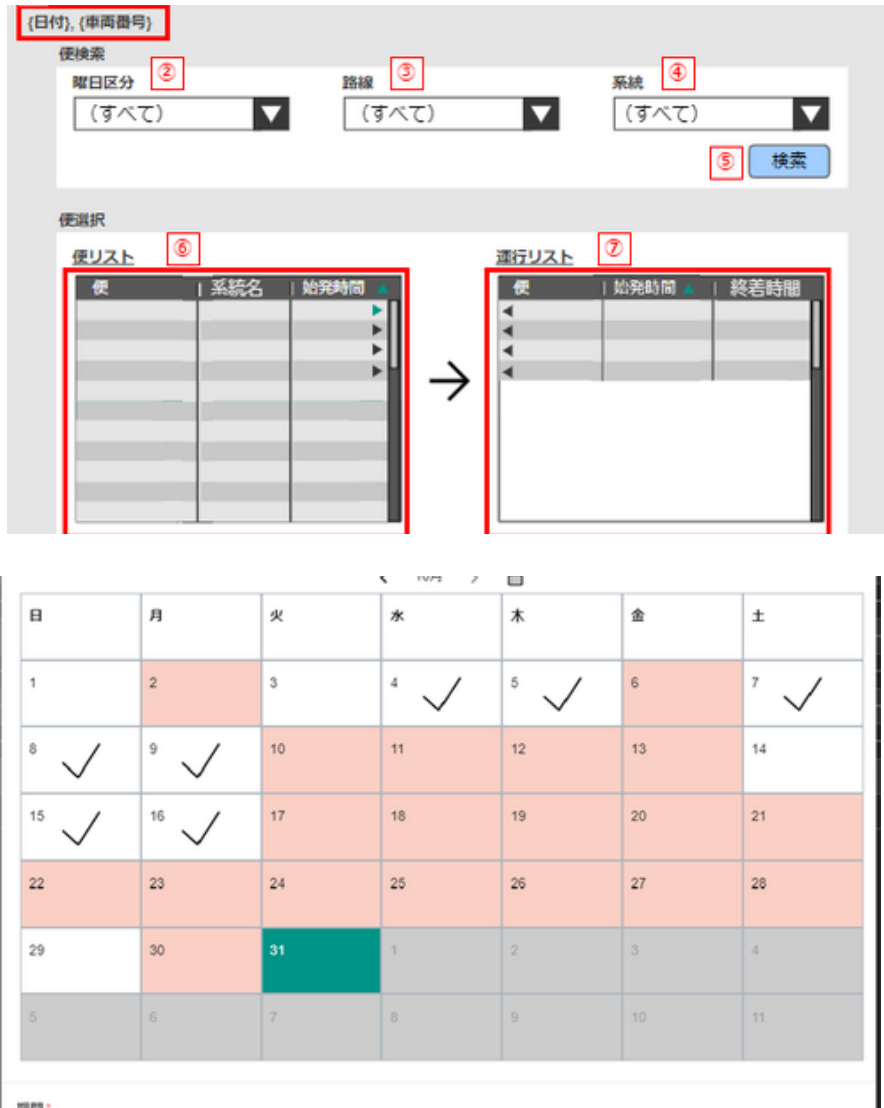
USER CASE: Vehicle Dispatch Scheduling



USER CASE: Create & Manage Vehicle Dispatch Schedules

Key Functions:

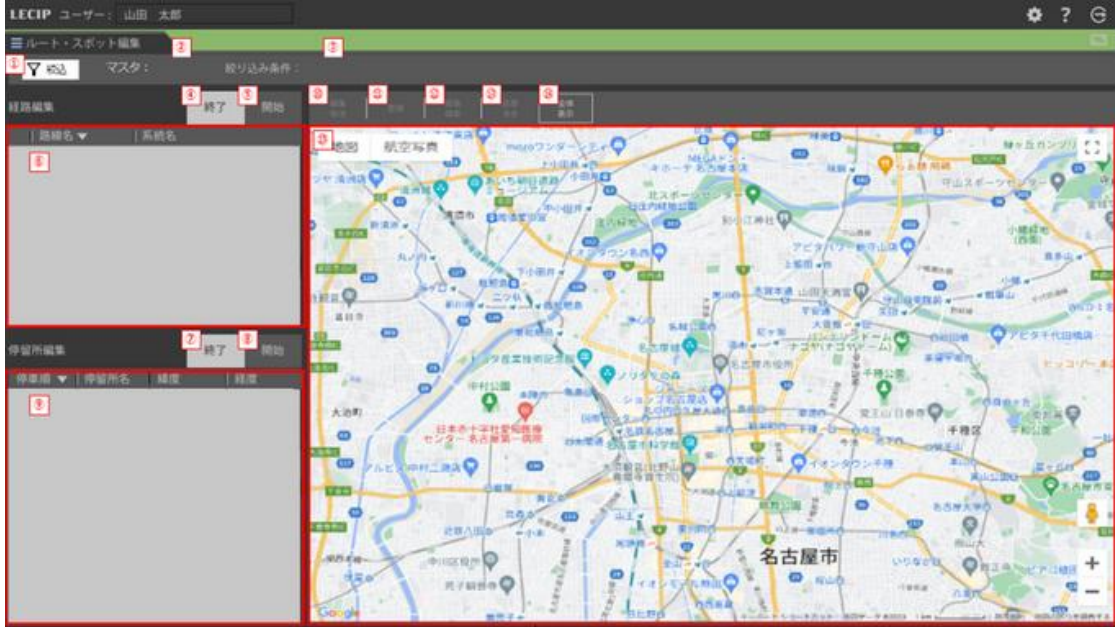
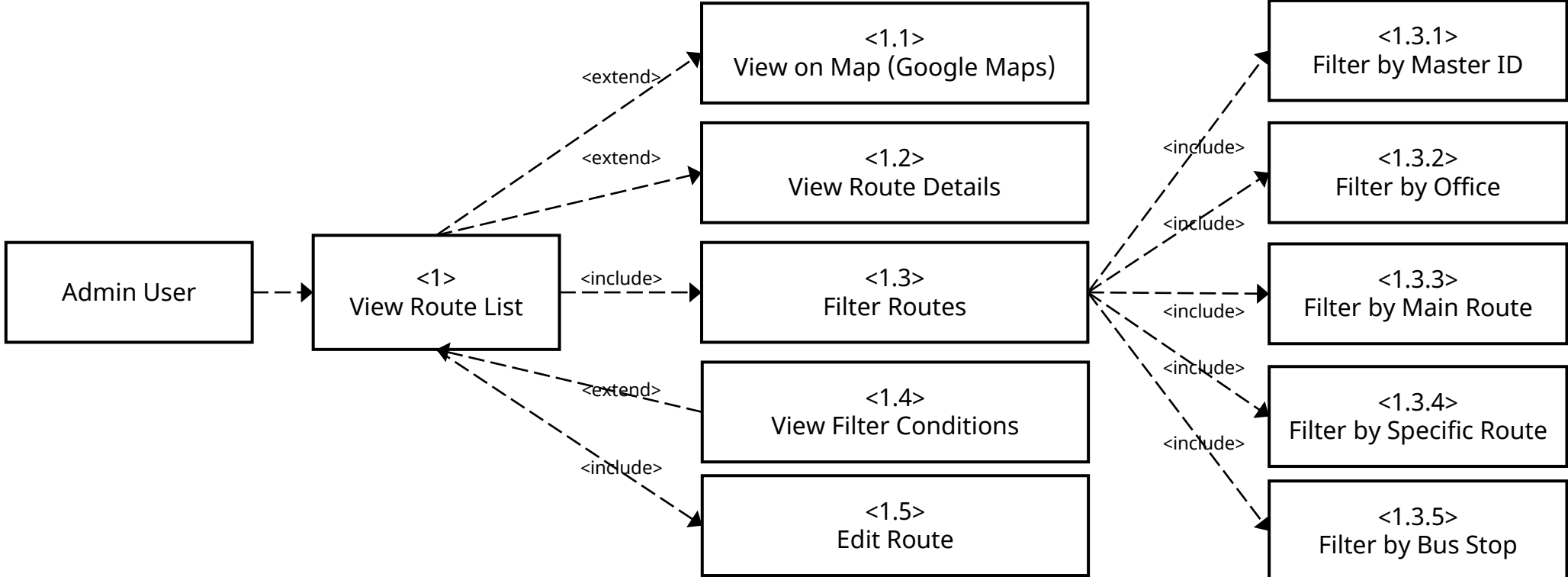
- Create and configure **bus operation schedules**
- Assign drivers and routes to each vehicle
- Set and update **working shifts** per vehicle
- Search for schedules by vehicle or date
- Export schedules as CSV files for reporting



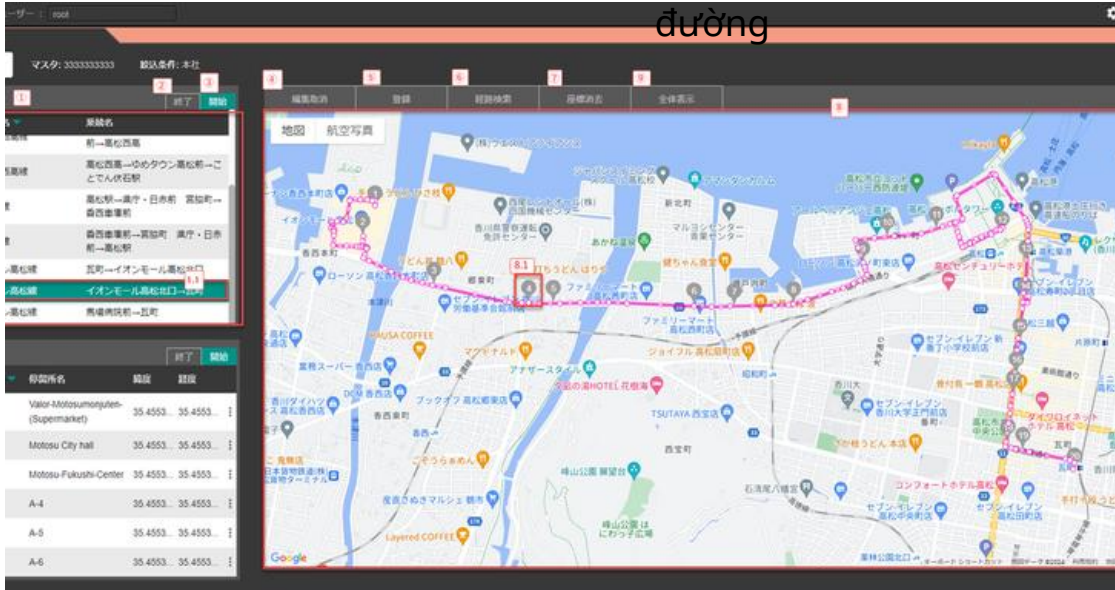
USER CASE: Route Management

Key Functions:

- View list of all registered bus routes
- **Edit existing routes** directly on the map
- Add, remove, or reconfigure bus stops on a route
- Monitor active/inactive route statuses



Chỉnh sửa tuyến đường



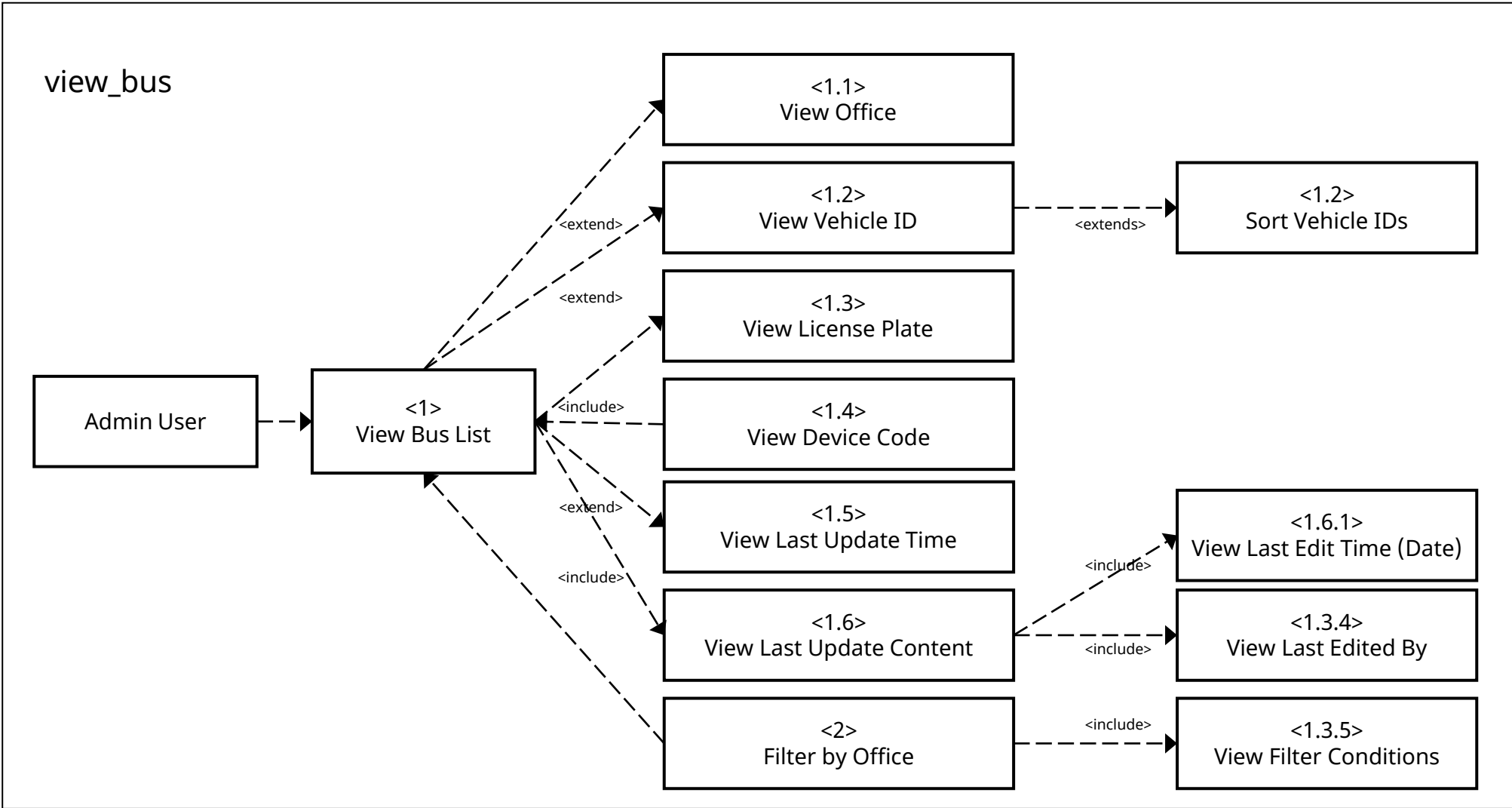
edit coordinates



USER CASE: Bus Management

Key Functions:

- Register new buses into the system
- View all registered buses
- Edit vehicle details (plate number, office, type, etc.)
- Remove buses when no longer in operation
- Export the full list of buses as CSV



USER CASE: Passenger - Bus Search

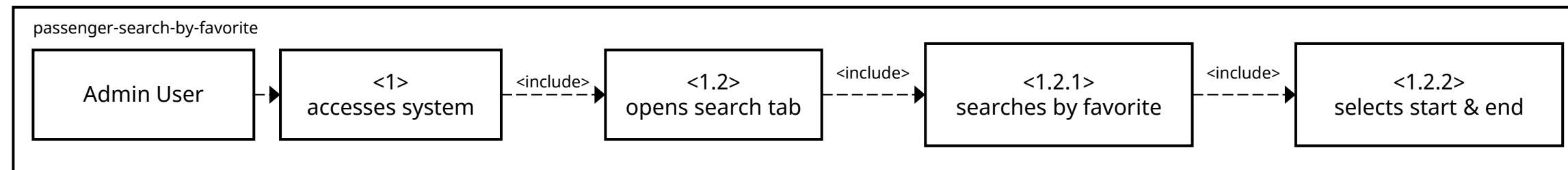
Key Functions:

Search for buses by:

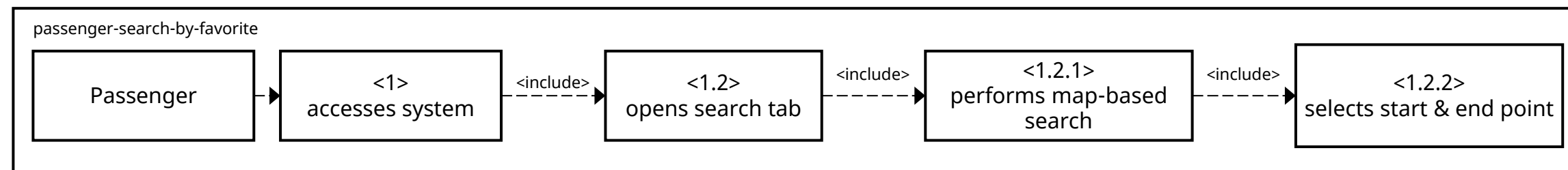
- Commonly used routes
- Destination or bus stop
- Map-based navigation

View upcoming schedules and live ETA (if available)

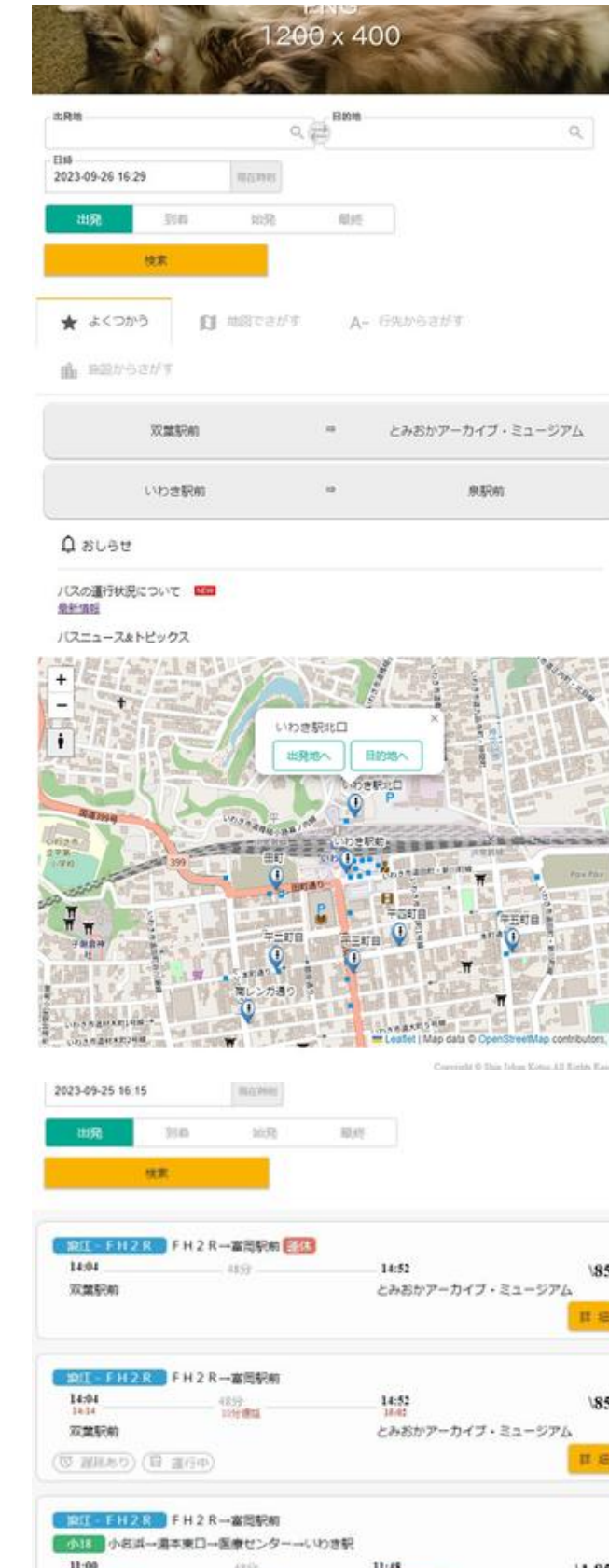
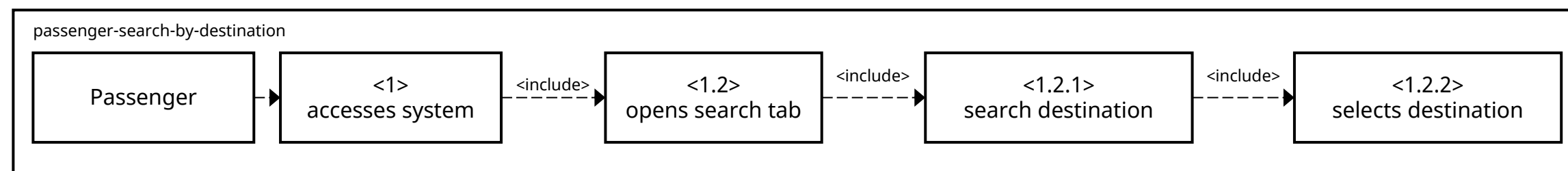
Commonly used routes



Map-based navigation



Destination or bus stop



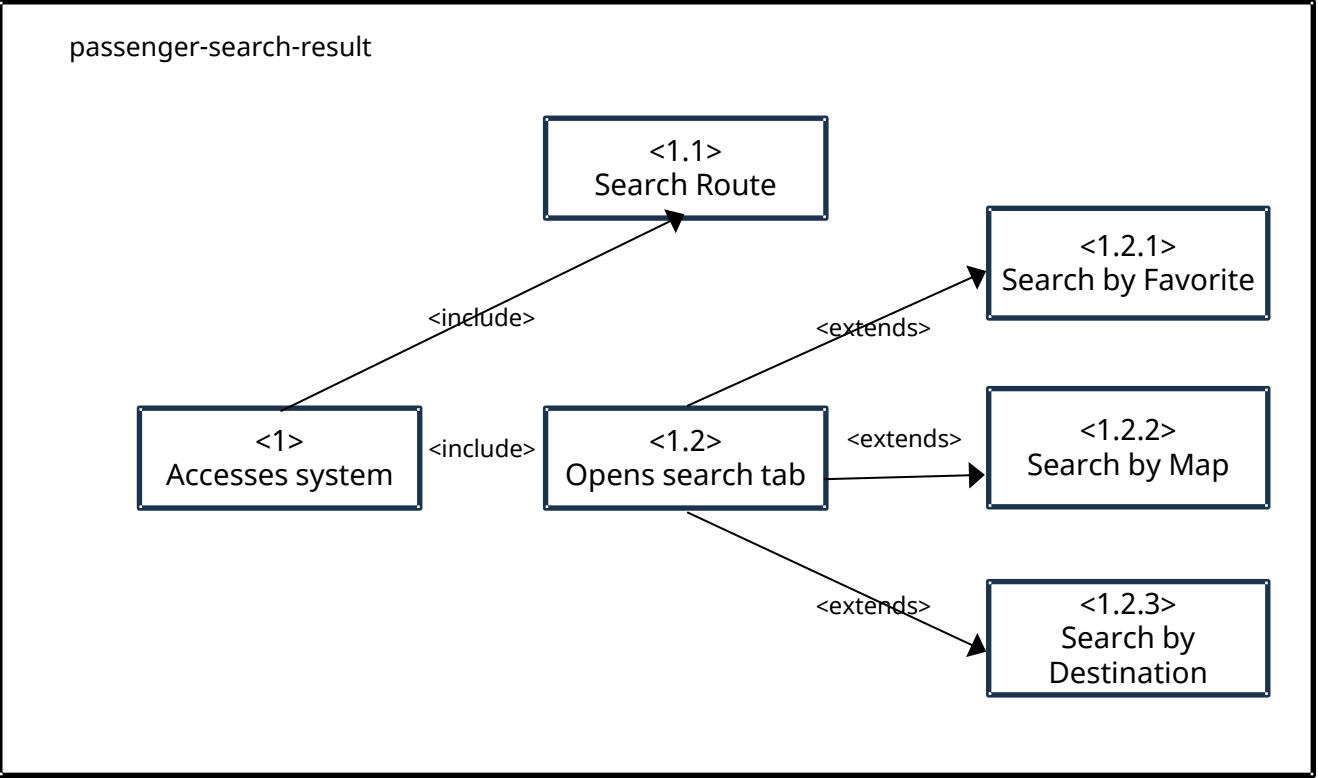
USER CASE: Passenger - Search Result & Trip Details

Key Functions:

- View **search result list** with detailed info:
 - Route, schedule, and stop info
- Access trip-related **notifications or policy changes**



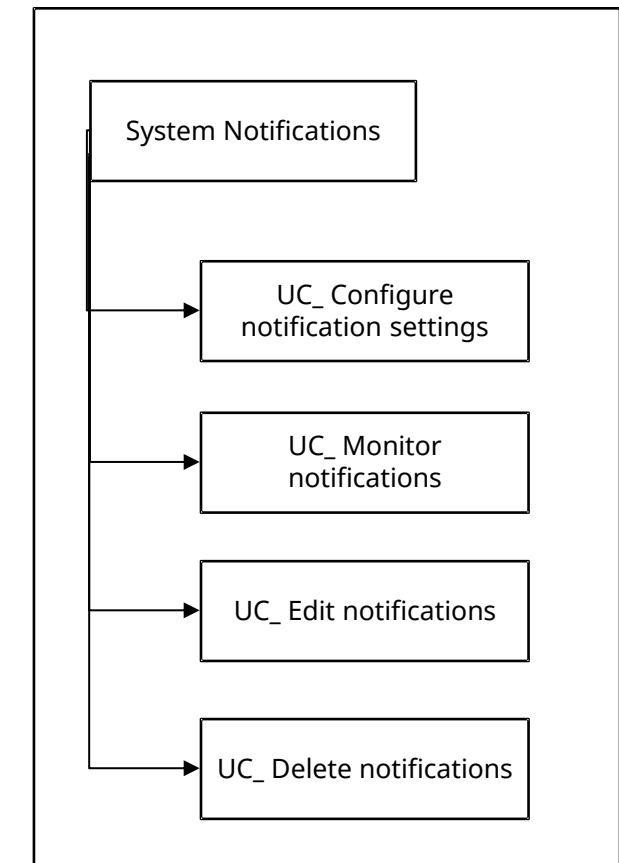
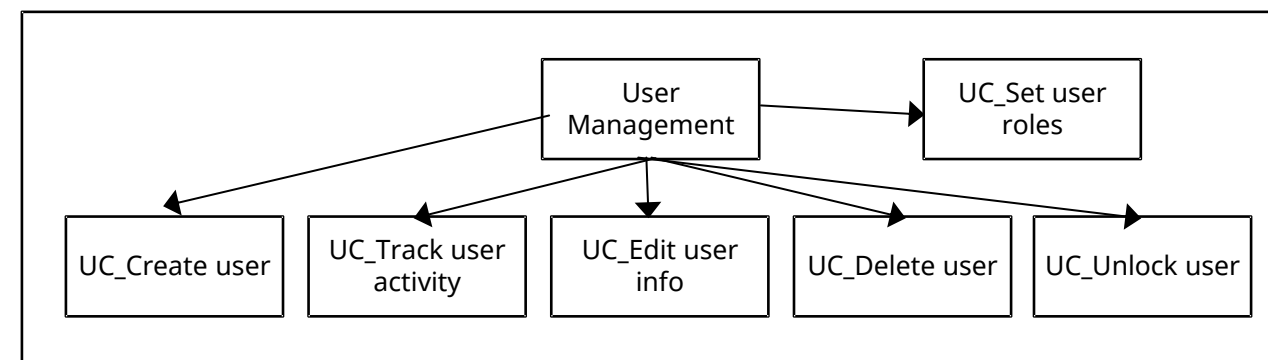
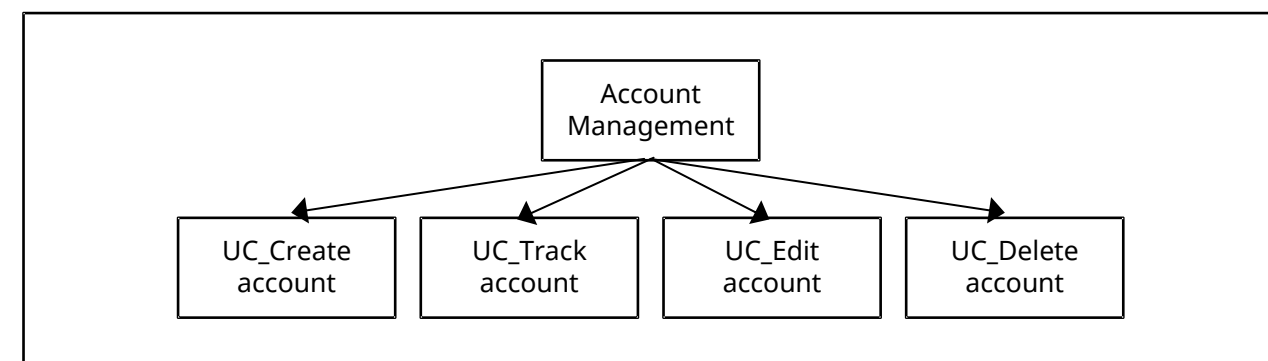
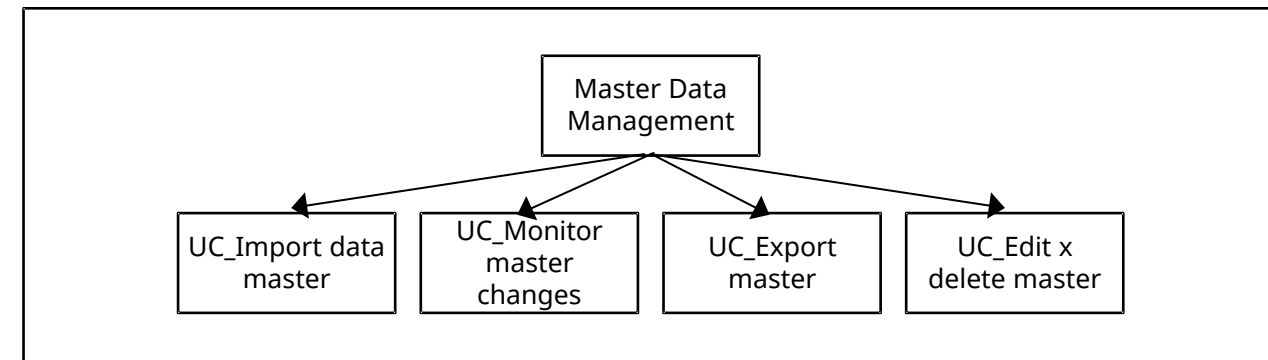
Searching result



USER CASE: Other Functionalities for admin

Other than the core features, administrators also have access to:

- **User management** (create/edit/delete accounts)
- **Access control** by roles
- System configuration and notification setup



TECHSTACKS

Infrastructure: Using cloud AWS services



AWS WAF



Amazon CloudFront



Amazon S3



AWS Cognito



Amazon API Gateway



AWS Lambda



Amazon DynamoDB



Amazon OpenSearch Service



Amazon CloudWatch



AWS Identity and Access Management (IAM)



AWS CodeBuild

GitLab: CI/CD, auto Deploy + sonar check



CI/CD

AutoDeploy



auto Deploy + sonar check



sonarqube

Programming language



Back-End: Python



Font-End: Vue 3

Google

Google Maps APIs

Google map API

Google Maps Transit

Google transit API



LUVINA SOFTWARE

PROJECT IMPLEMENTATION & MANAGEMENT



PROJECT LIFE CYCLE

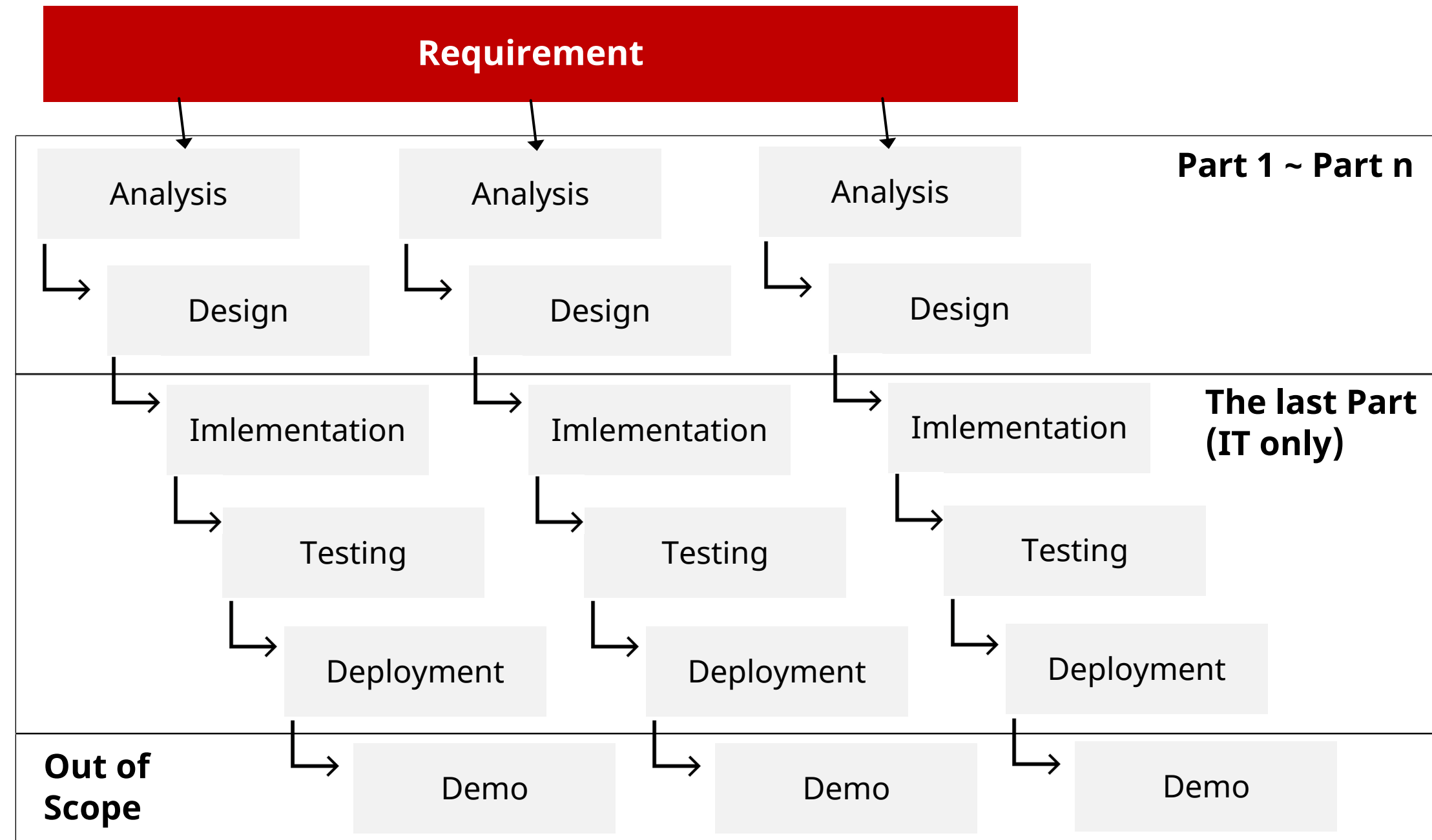
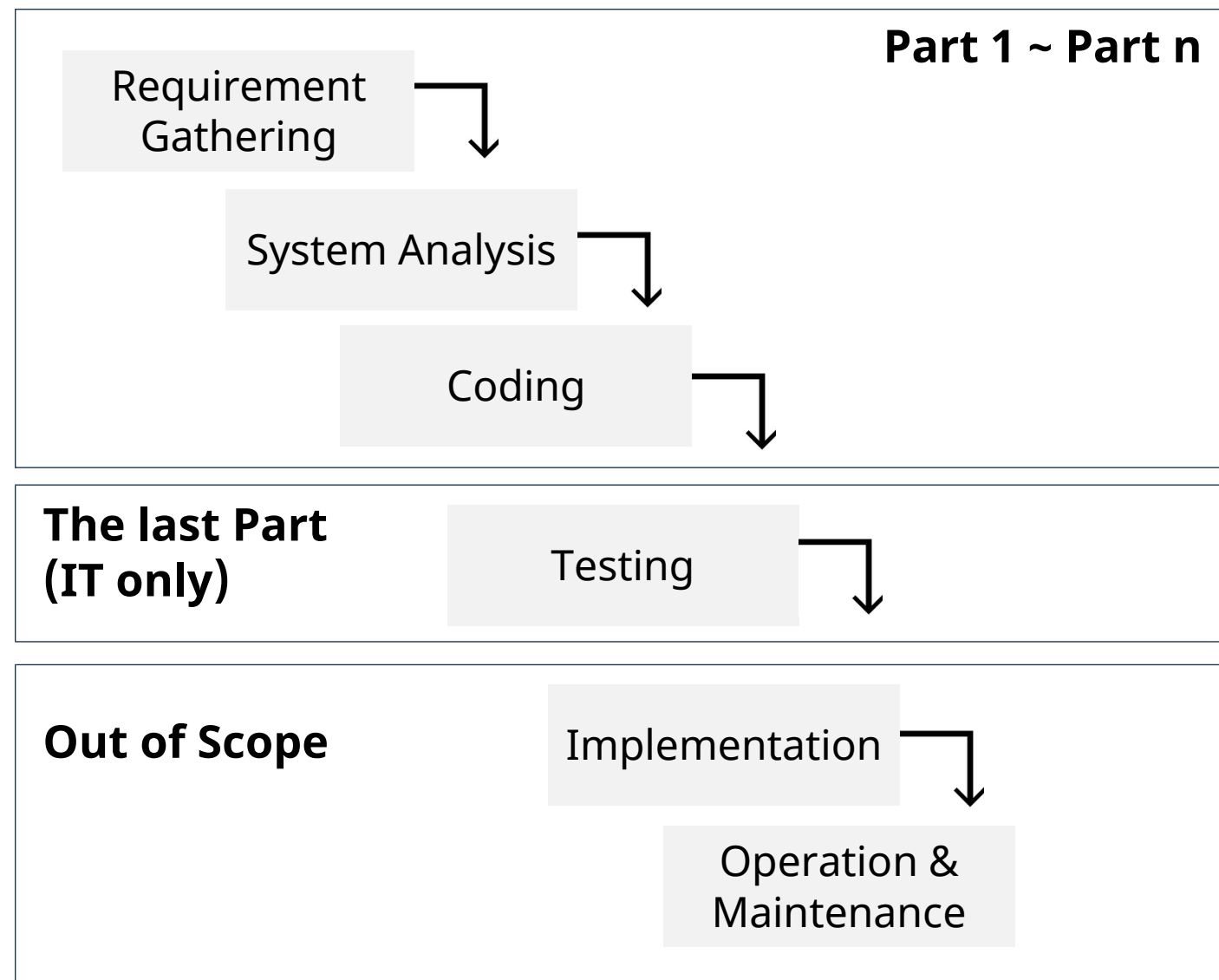
Project life cycle (Master schedule imagine)

Do the same in the next Parts

| | •Week 1 | •Week 2 | •Week 3 | •Week 4 | •Week 5 | •Week 6 |
|---------------|---------------|---------|---------------|---------------|---------------|---------------|
| •URD | Part 1 | | Part 2 | | Part 3 | |
| •SRS & UI | | | | | | |
| •Mockup | | | Part 1 | | Part 2 | |
| •API | Design part 1 | | Coding part 1 | Design part 2 | Coding part 2 | Design part 2 |
| •Frontend | | | Coding part 1 | | Coding part 2 | |
| •Smock test | | | Create part 1 | Test part 1 | Create part 2 | Test part 2 |
| •SAD | Update | | | | | |
| •Infra Design | | | | | | |

PROJECT LIFE CYCLE

Project file cycle visualization



TIMELINE

DESIGN-CODE

Design:

- + SAD
- + Infra Design
- + URD
- + SRS
- + API Design

Code:

- + Font End
- + Backend
- + Smock

TEST

01/2023 - 12/2023

Development

Part 1: Account Authentication & User Roles

- UC1: Admin User Login
- UC2: Root User Account Management
- UC4: Root User Login
- UC12: General User Login

Part 2: User & Master Data Management

- UC5: Manage Non-Root Users
- UC6: Master Data Management

Part 3: Bus Operation Monitoring

- UC11: Operation Report Monitoring
- UC13: Route Tracking
- UC14: Bus Tracking

Part 4: Bus Devices & Scheduling

- UC9: Bus Device Management
- UC10: Bus Schedule Management

Part 5: Route & Vehicle Management

- UC7: Route Management
- UC8: Bus Management

Part 6: Notifications, Settings, Search

- UC3: Notification Management
- UC18: System Settings
- UC16.1: Search by Destination
- UC16.2: Search via Map

Part 7: UI Personalization & Language Options

- UC15: Policy Information Display
- UC16.3: Search by Trip History
- UC17: Language Preferences

Test:
Test IT
Test System

12/2023 - 03/2024

CR

- Additional features were developed beyond the original scope, based on evolving business needs.
- Luvina handled CRs efficiently to ensure smooth deployment and alignment with customer expectations.

Test:
Test IT
Test System

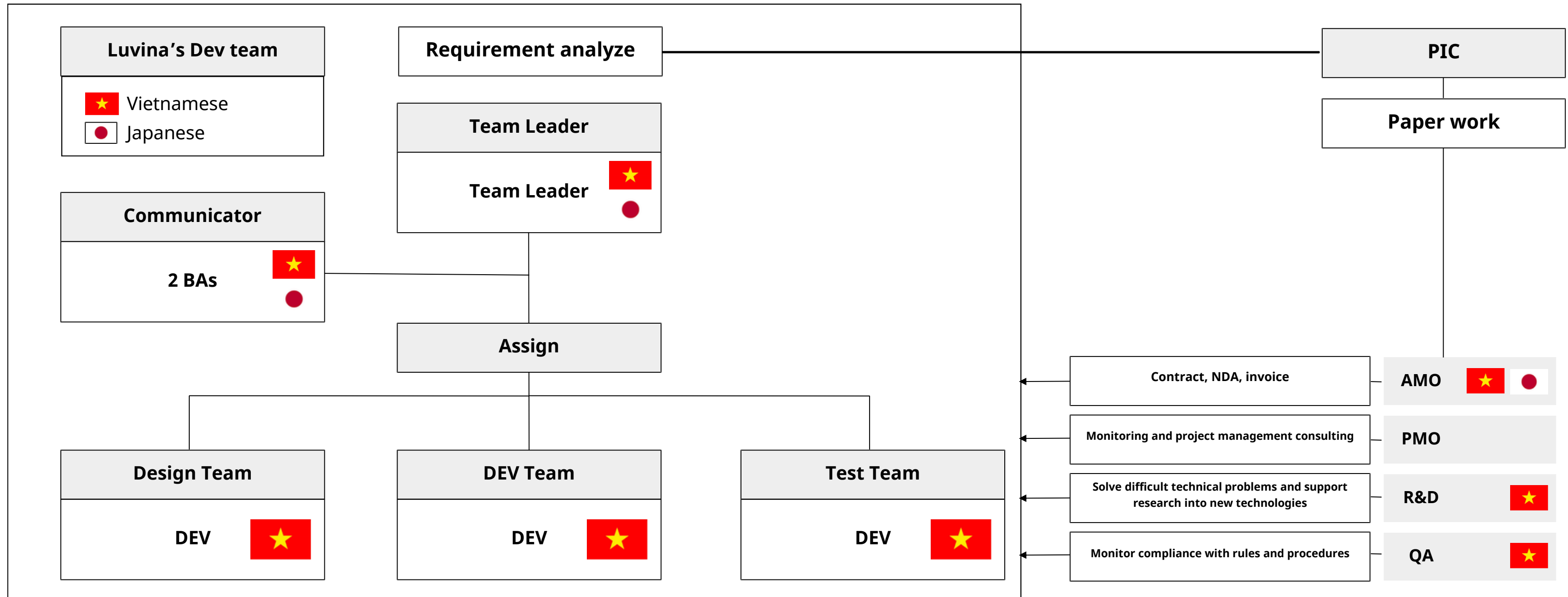
04/2024 - now

Post-launch Maintenance

- Continued support for feature enhancements and system maintenance.
- Implementation of new feature modules as per customer feedback and operational needs.

Test:
Test IT
Test System

TEAM STRUCTURE



Thank You

CONTACT US



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