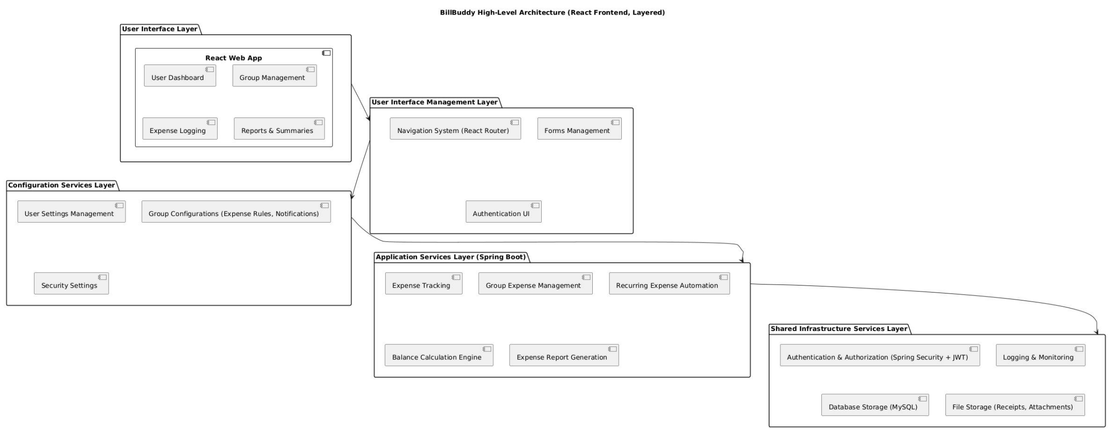
High-Level Architecture Diagram


BillBuddy High-Level Architecture (React Frontend, Layered)
User Interface Layer
React Web App
User Dashboard
Group Management
Expense Logging
Reports & Summaries
User Interface Management Layer
Navigation System (React Router)
Forms Management
Authentication UI
Configuration Services Layer
User Settings Management
Group Configurations (Expense Rules, Notifications)
Security Settings
Application Services Layer (Spring Boot)
Expense Tracking
Group Expense Management
Recurring Expense Automation
Balance Calculation Engine
Expense Report Generation
Shared Infrastructure Services Layer
Authentication & Authorization (Spring Security + JWT)
Logging & Monitoring
Database Storage (MySQL)
File Storage (Receipts, Attachments)

1. Define a modular component structure for your project.

User Interface Layer

This layer provides the front-end interaction for users through React applications.

Components:

- **Mobile App**
  - User dashboard
  - Group management
  - Expense logging
  - Reports and summaries

User Interface Management Layer

This layer is responsible for handling UI operations and navigation, ensuring smooth user experience.

Components:

- **Forms management**: Expense entry, group creation
- **Navigation system**: React Navigation
- **Authentication UI**: Login, signup, password recovery

Configuration Services Layer

This layer enables system customization and configuration based on user preferences and group settings.

Components:

- **User settings management**
- **Group configurations** (Expense rules, notification settings)
- **Security settings**

Application Services Layer

This is the core business logic layer that handles expense tracking and financial calculations.

Components:

- **Expense tracking**: Log, edit, and delete expenses
- **Group expense management**: Split costs among members
- **Recurring expense automation**: Monthly rent, subscriptions
- **Balance calculation engine**: Tracks debts and settlements
- **Expense report generation**

Shared Infrastructure Services Layer

This is the backend and storage layer, ensuring security, authentication, and data storage.

Components:

- **Authentication & Authorization (Spring Security + JWT)**
- **Logging & monitoring**: Tracks errors and user activity
- **Database storage (MySQL)**: Users, groups, expenses, logs
- **File storage**: Uploading receipts for expenses

2. Identify dependencies between components and discuss potential coupling issues.

User Interface Layer → User Interface Management Layer

- **Dependency:** The React relies on the navigation system and forms management to handle user interactions.
- **Potential Coupling Issue:** If the forms management or navigation system is tightly coupled to the UI components, any changes to navigation (e.g., adding a new user flow) might require modifying multiple UI components.

User Interface Management Layer → Configuration Services Layer

- **Dependency:** The UI forms and settings pages depend on user settings management and group configurations to fetch data dynamically.
- **Potential Coupling Issue:** If UI management directly fetches configuration data from the backend without a caching layer, it can lead to performance bottlenecks due to frequent API calls.

Configuration Services Layer → Application Services Layer

- **Dependency:** Group settings (e.g., expense split rules) directly influence how expenses are processed.
- **Potential Coupling Issue:** If configuration settings are deeply embedded in the expense tracking logic, changing group rules may require modifying the core expense tracking service, increasing the risk of breaking other functionalities.

Application Services Layer → Shared Infrastructure Services Layer

- **Dependency:** The expense tracking module and group management module rely on MySQL storage, authentication, and logging services to ensure accurate data handling.
- **Potential Coupling Issue:** If the expense tracking service is tightly coupled to MySQL queries, migrating to another database or making schema changes will be difficult.

3. Outline a strategy for handling updates in different components over time

API Versioning Strategy (Back-End - Spring Boot)

Problem: Changes in the API can break existing front-end functionality if not managed properly.

Solution: Implement **REST API versioning** to maintain backward compatibility.

Implementation:

- **Versioning in URL paths**: Maintain multiple API versions (e.g., /api/v1/expenses and /api/v2/expenses).
- **Deprecation strategy**: Keep older API versions for a defined period before phasing them out.

Front-End Component Versioning

Problem: UI changes may cause disruptions for existing users if deployed without proper control.

Solution:
Component-Based Updates: Use a modular React architecture where components are updated independently (e.g., updating the dashboard without modifying group management).

Database Migration

Problem: Schema changes may cause data inconsistency or downtime.

Solution: Use Flyway for automated database migrations.

Implementation:

- Store migration scripts in version-controlled SQL files.
- Apply migrations incrementally without affecting running services.