

**CHUBB**<sup>®</sup>

**CAPSTONE PROJECT  
(Loan Management System)**

Enterprise-Grade Secure Full-Stack Web Application

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## **(flight app with angular)**

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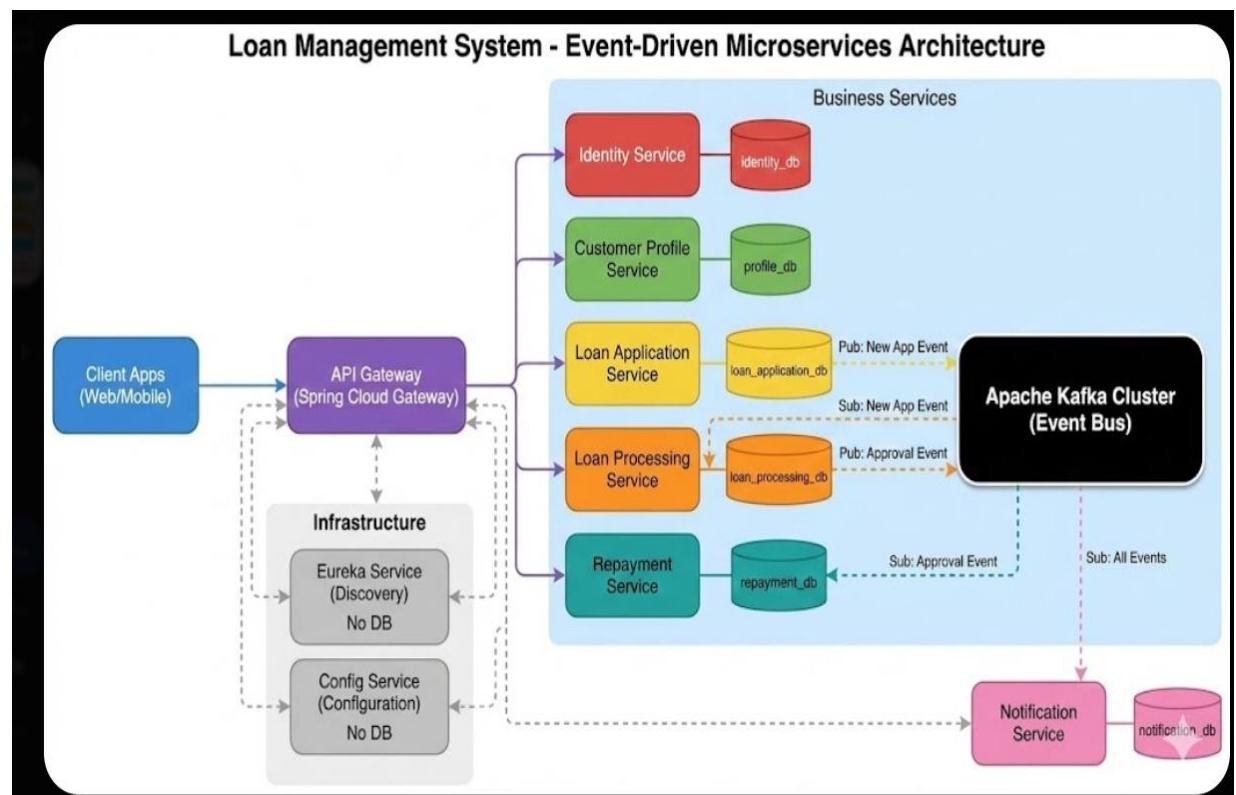
# **1) Purpose of the document**

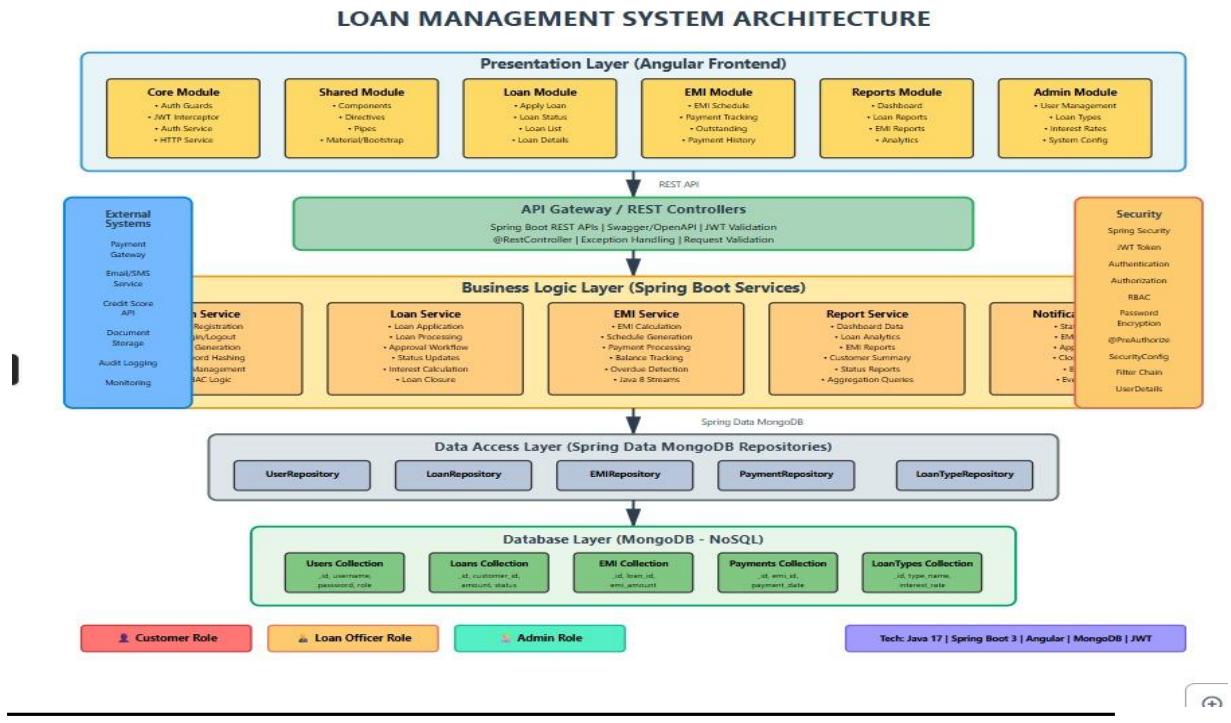
This document serves as the **authoritative technical and architectural reference** for the **Loan Management System (LMS)**.

Its primary objectives are to:

- Explain the **business rationale and system vision**
- Provide a **high-level system overview** for stakeholders
- Describe the **architectural style, core components, and design decisions**
- Detail the **microservice responsibilities, APIs, and data ownership**
- Define **security, error handling, validation, and non-functional requirements**
- Present a **robust testing and quality assurance strategy**

## **System Overview**





## 2.1 Business Objective

The Loan Management System is designed to **digitize and automate the end-to-end loan lifecycle** for banks, NBFCs, and financial institutions. The system replaces manual and semi-automated workflows with a **secure, scalable, and audit-ready platform**.

### Key business goals include:

- Faster loan application processing
- Transparent approval workflows
- Accurate EMI computation and repayment tracking
- Secure handling of sensitive financial data
- Real-time dashboards and operational reports
- Cloud-ready, API-first architecture

## 2.2 High-Level Features

- Multi-role system: Admin, Loan Officer, Customer
- Online loan application and tracking

- Configurable loan types, interest rates, and tenures
- Automated EMI schedule generation
- Repayment tracking and loan closure
- Secure authentication using JWT
- Role-based authorization (RBAC)
- Reporting and dashboard analytics
- Production-ready REST APIs

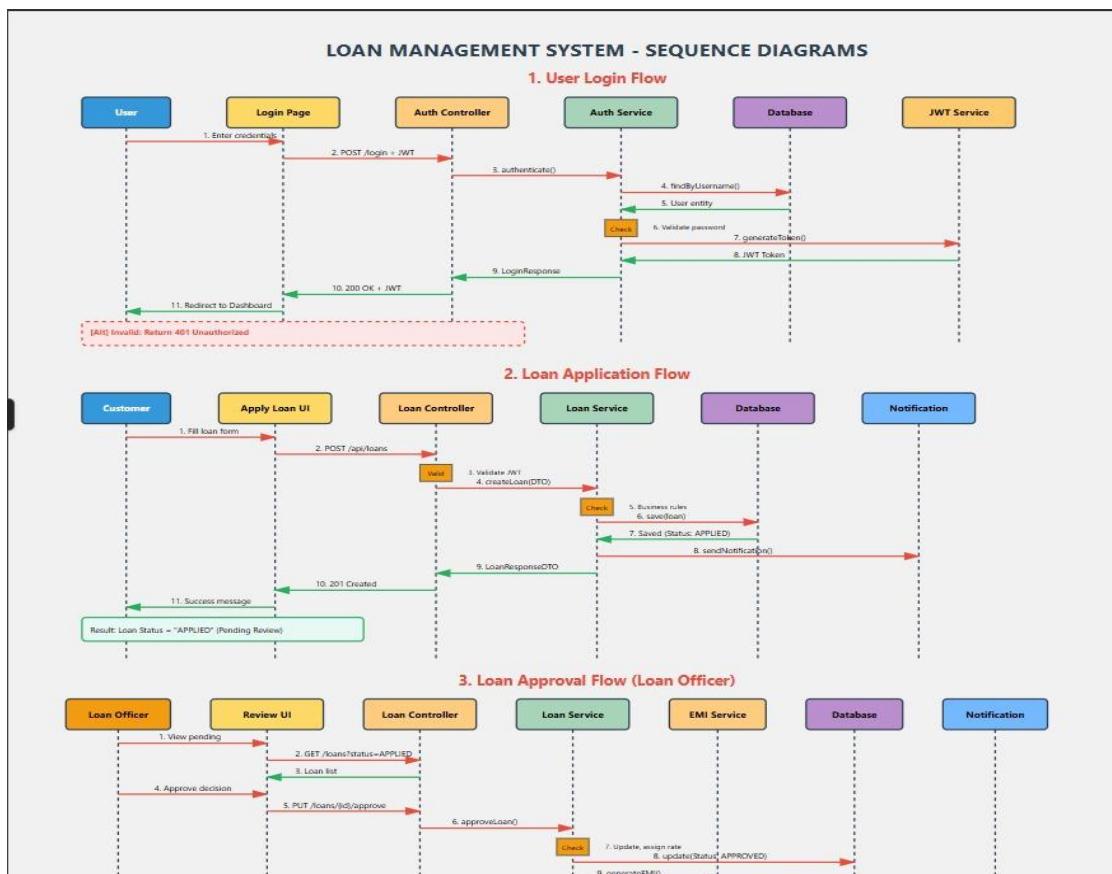
### 3. **Architecture Style**

#### 3.1 Architectural Pattern

The system follows a **Microservices-Oriented Architecture** combined with **Layered Design Principles**.

#### Key characteristics:

- Loose coupling between services
- Independent data ownership
- REST-based inter-service communication
- Stateless backend services
- Frontend-backend separation (SPA + APIs)



## **4. Core System Components**

### **4.1 Frontend Layer**

- Single Page Application (SPA)
- Handles UI rendering, form validation, and role-based navigation
- Communicates with backend via secured REST APIs

### **4.2 Backend Layer**

- Stateless REST services
- Implements business logic, validation, security, and workflows
- Exposes versioned APIs

### **4.3 Persistence Layer**

- Independent databases per service
- Ensures data isolation and scalability

### **4.4 Security Layer**

- · JWT authentication
- · Role-based authorization
- · Encrypted password storage
- · Secure API endpoints

## **5. Technology Stack**

### **5.1 Backend**

- Java 17+
- Spring Boot 3.x
- Spring Web (REST APIs)
- Spring Data JPA
- Hibernate ORM
- Spring Security with JWT
- Swagger / OpenAPI
- Maven

## 5.2 Frontend

- Angular (latest)
- TypeScript
- Angular Material / Bootstrap
- Reactive Forms
- HTTP Interceptors
- Route Guards

## 5.3 Database

- PostgreSQL / MySQL
- Separate schema per microservice

## 5.4 DevOps & Tools

- Git & GitHub
- Postman
- Environment-based configuration (dev/test/prod)

## 5.5 Testing

- JUnit 5
- Mockito
- Postman collections

# **6. Microservice Design**

## **6.1 User Service**

### Responsibilities

- User registration and authentication
- Role and permission management
- JWT generation and validation
- Password hashing and security policies

## APIs

- POST /auth/register
- POST /auth/login
- GET /users
- GET /users/{id}
- PUT /users/{id}
- DELETE /users/{id}

## Database

- User table
- Role table
- User-Role mapping table

## **6.2 Product Service (Loan Service)**

### Responsibilities

- Loan type management
- Interest rate and tenure rules
- Loan application submission
- Loan status lifecycle management

## APIs

- POST /loans/apply
- GET /loans/{id}
- GET /loans/customer/{customerId}
- PUT /loans/{id}/approve
- PUT /loans/{id}/reject

## Database

- Loan table
- Loan type table
- Loan status history table

## **6.3 Order Service (EMI & Repayment Service)**

### **Responsibilities**

- EMI calculation
- EMI schedule generation
- Repayment tracking
- Outstanding balance computation
- Automatic loan closure

### **APIs**

- GET /emis/loan/{loanId}
- POST /emis/pay
- GET /repayments/customer/{customerId}

### **Database**

- EMI schedule table
- Repayment table
- Loan balance table

## **7. Data Design (Low-Level Design)**

### **7.1 User Document**

- userId
- name
- email
- password (hashed)
- role
- status
- createdAt

### **7.2 Product (Loan) Document**

- loanId
- customerId
- loanType
- principalAmount
- interestRate

- · tenure
- · status
- · approvalRemarks

### 7.3 Order (EMI) Document

- · emild
- · loanId
- · dueDate
- · emiAmount
- · paidAmount
- · outstandingBalance
- · paymentStatus

## **8. API Design & Validation**

- RESTful conventions followed
- DTOs used for request/response
- Input validation using @Valid
- Custom validators for:
- Loan amount limits
- Tenure constraints
- · EMI payment rules

## **9. Error Handling Strategy**

### 9.1 Global Exception Handling

- Centralized exception management using @ControllerAdvice
- Custom exceptions:
- ResourceNotFoundException
- ValidationException
- UnauthorizedAccessException
- Standardized error response format:
- timestamp
- status
- errorCode
- message
- Pat

## **10. Security Design**

- JWT-based authentication
- Stateless session management
- Role-based access control
- Password hashing using BCrypt
- Secured endpoints with method-level authorization
- HTTP interceptors for token propagation

## **11. Non-Functional Requirements**

- Scalability: Horizontally scalable services
- Security: Encrypted credentials and secure APIs
- Performance: Optimized queries and pagination
- Maintainability: Clean layered architecture
- Availability: Fault-tolerant stateless services
- Auditability: Complete loan lifecycle traceability

## **12. Testing Strategy**

### **12.1 Unit Testing**

- Service-layer tests using JUnit and Mockito
- Mocked repositories and external dependencies

### **12.2 API Testing**

- Postman collections for all endpoints
- Authentication and authorization test cases

### **12.3 Validation & Security Testing**

- Input validation tests

- Unauthorized access tests
- Token expiry handling

## **Conclusion**

The Loan Management System demonstrates **enterprise-level system design**, **secure full-stack development**, and **real-world financial workflows**. It is **production-ready**, **cloud-deployable**, and built using **industry best practices**, making it a strong representation of modern backend and frontend engineering capabilities.