Architecture Document of ERP System

Contents

1 Introduction

The **Konecta ERP System** is a comprehensive, enterprise-grade web application designed to streamline and integrate critical business functions including **Human Resources (HR)**, **Finance**, and **Inventory Management** within a unified, secure, and scalable platform.

The system is built using a **microservices architecture**, ensuring modularity, independent scalability, and flexible deployment. Each service operates independently while seamlessly communicating through well-defined REST APIs, allowing organizations to scale specific modules based on business needs without affecting the entire system.

1.1 System Purpose and Value Proposition

The Konecta ERP System addresses the critical need for integrated business process management by:

- **Centralizing Operations:** Providing a single source of truth for employee data, financial transactions, and inventory levels, eliminating data silos and reducing manual data entry errors.
- **Automating Workflows:** Streamlining routine tasks such as payroll calculation, attendance tracking, and inventory movements, freeing up staff to focus on strategic initiatives.
- **Enhancing Employee Self-Service:** Empowering employees to manage their own attendance, submit leave requests, view payroll information, and track performance metrics through an intuitive portal.
- **Enabling Real-Time Decision Making:** Delivering comprehensive dashboards and analytics that provide instant visibility into HR metrics, financial performance, inventory levels, and operational KPIs.
- **Ensuring Compliance and Security:** Implementing role-based access control, audit logging, and secure authentication mechanisms to protect sensitive organizational data and ensure regulatory compliance.

1.2 System Objectives

- Automate HR and Finance workflows for efficiency and transparency.
- Enable employees to self-manage attendance, leaves, and payroll information.
- Provide real-time dashboards and reports to HR, Finance, and Inventory managers.
- Ensure data integrity, security, and scalability using cloud deployment.
- Integrate inventory management for complete business process coverage.

1.3 Core Modules

1. **Auth Service:** Handles JWT-based authentication, user registration, password management, and secure access control across all modules.
2. **HR Service:** Manages the complete employee lifecycle including recruitment, employee records, attendance tracking, leave management, training programs and performance evaluations.
3. **Finance Service:** Manages payroll processing, expense tracking and approval, invoicing, and financial reporting and calculations based on attendance and performance data.

4. **Inventory Service:** Tracks items, warehouses, stock levels, and inventory movements (receipts, issues, adjustments) with low-stock alerts and real-time inventory visibility.

5. **Reporting Service:** Built using ASP.NET Core; generates comprehensive analytics dashboards, exportable PDF/Excel reports, and cross-module summaries for HR, Finance, and Inventory data.

6. **Admin Portal:** Provides centralized control, system-wide analytics, user management, and configuration settings.

7. **Employee Portal:** Enables employees to view and manage their own data including attendance, leaves, salary, performance, and training enrollments.

2 System Architecture Overview

The ERP system follows a **microservices-based architecture** with independent backend services connected through REST APIs. This architecture enables each service to be developed, deployed, and scaled independently while maintaining loose coupling and high cohesion.

2.1 Architecture Components

- **Frontend:** Angular 18 web application providing separate dashboards for HR, Finance, Inventory, Admin, and Employee roles with responsive design and real-time data updates.

- **Backend Microservices:** Spring Boot 3.5.6 microservices (Auth, HR, Finance, Inventory) built with Java 21, each with its own database schema for data isolation.

- **Reporting Service:** ASP.NET Core 8.0 microservice integrated via REST APIs for generating and exporting reports in PDF and Excel formats.

- **Database:** PostgreSQL with separate schemas per service (auth, hr, finance, inventory) ensuring data isolation and independent scaling.

- **API Gateway:** Spring Cloud Gateway for centralized routing, load balancing, and request/response transformation.

- **Service Discovery:** Eureka Server for dynamic service registration and discovery, enabling automatic service location and failover.

- **Configuration Management:** Spring Cloud Config Server for centralized configuration management across all microservices.

- **Security:** JWT authentication with role-based authorization (ADMIN, HR, FINANCE, INVENTORY, EMPLOYEE) enforced at the API gateway and service levels.

- **Deployment:** Docker containers orchestrated with Docker Compose, supporting CI/CD pipeline integration for automated testing and deployment.

2.2 System Architecture Diagram

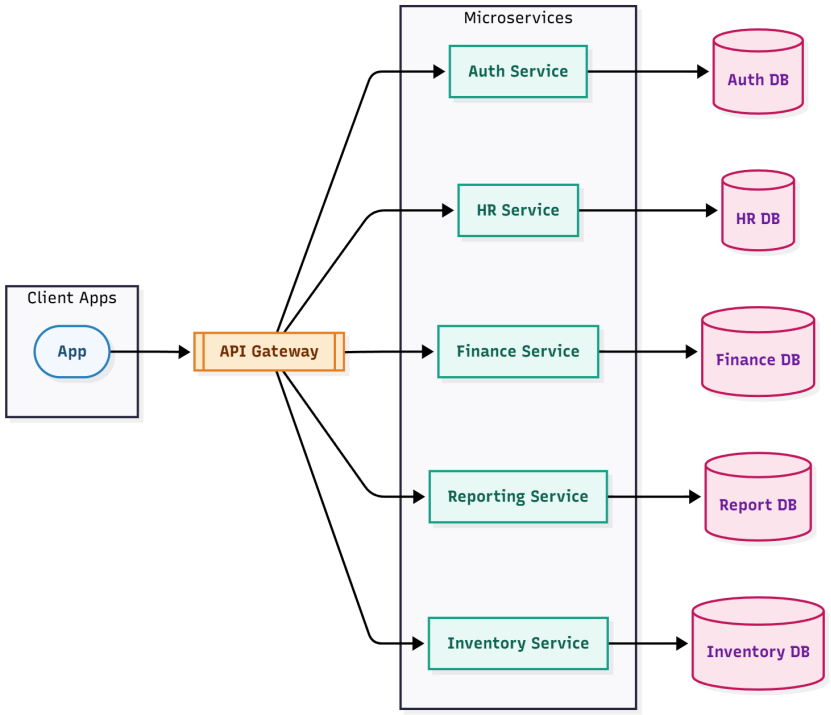

Figure 1: Microservice Diagram

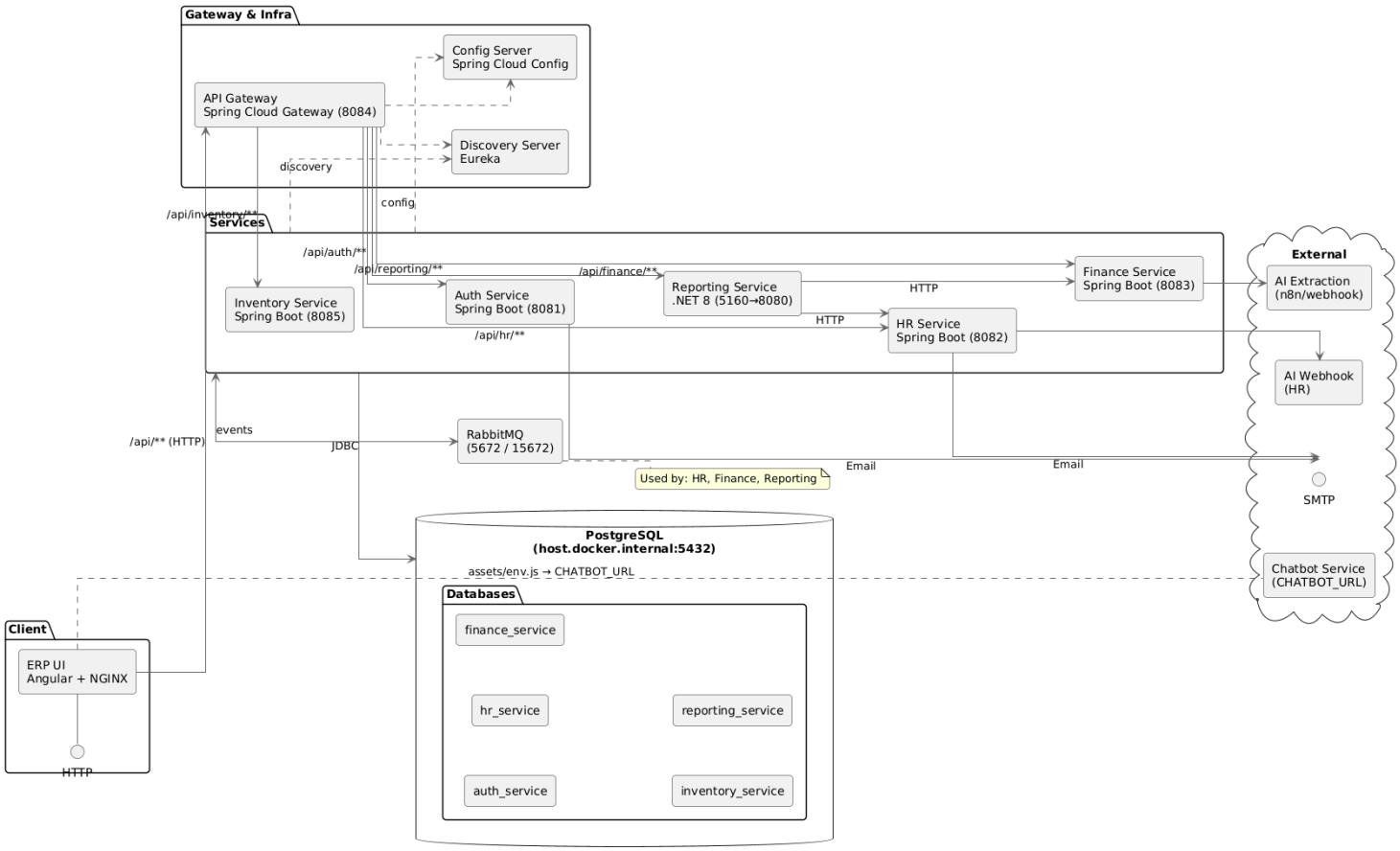

Figure 2: Component Diagram

2.3 Database Architecture Overview

The system uses PostgreSQL as the primary database with separate schemas for each microservice:

- **Auth Schema:** User accounts, roles, registration tokens, and authentication data.
- **HR Schema:** Employee records, departments, attendance, leaves, training programs, performance reviews, recruitment, and offboarding data.
- **Finance Schema:** Payroll records, expenses, invoices, and financial transactions.
- **Inventory Schema:** Items (SKU, descriptions, units), warehouses, stock levels, and movement history (IN, OUT, ADJUST).

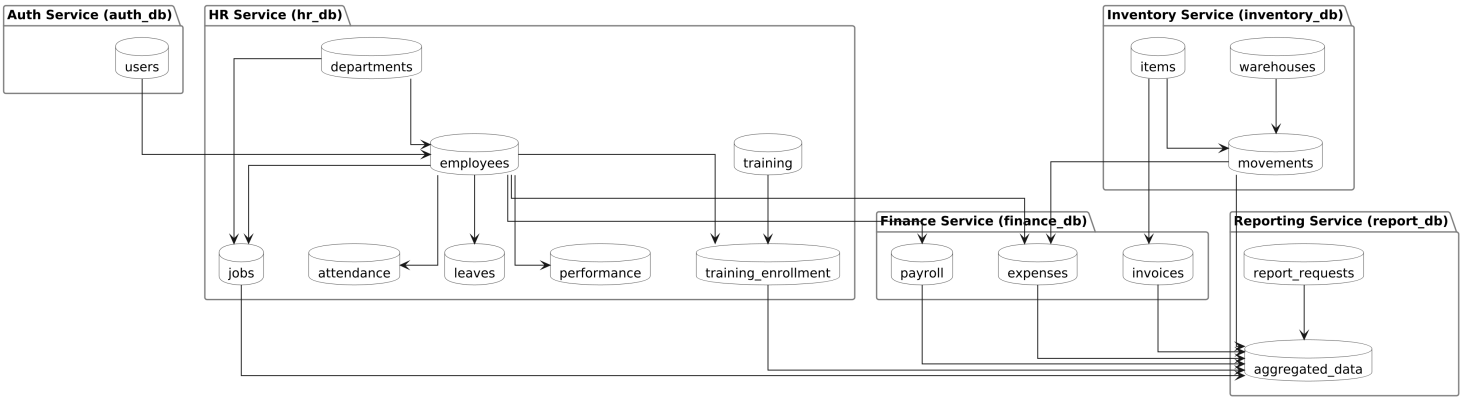

Figure 3: High-level Database Architecture

2.4 Detailed Database Schema (ERD)

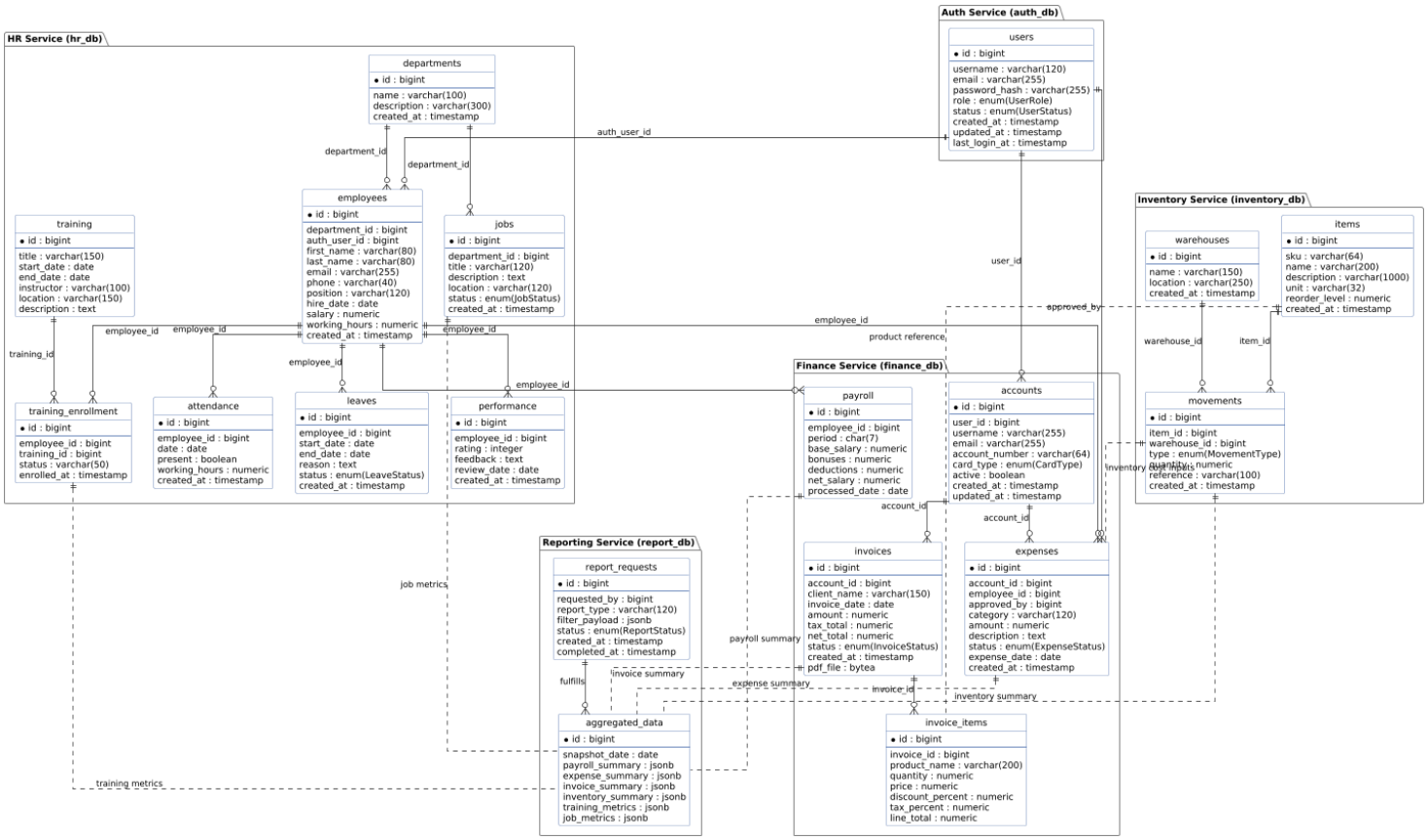

Figure 4: Low Level ERD Diagram

3 HR Module Architecture

The **HR Service** automates the complete employee lifecycle, from recruitment and onboarding through active employment management to offboarding. It integrates attendance tracking, training management, performance evaluations, and leave management for a seamless HR workflow. The service also includes AI-powered assistance for HR decision-making and best practices.

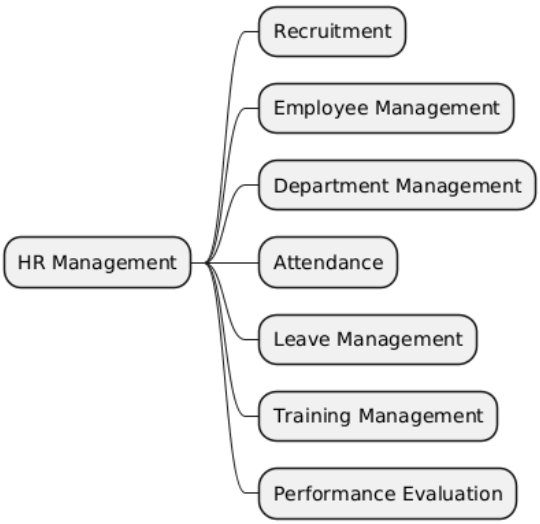

Figure 5: HR-mindmap

Table 1: HR Sub-Modules Overview

Sub-Module	**Description**	**ERP Output**
Recruitment	Job requisition, posting, application tracking, interviews, and offers	Hired candidates added to employee master list
Employee Management	Employee registration, profile updates, department assignment, and employee records maintenance	Complete employee database with role assignments
Department Management	Organizational structure management, department creation, and employee-department relationships	Department hierarchy and reporting structure
Attendance	Check-in/out tracking, absence records, working hours calculation, and overtime tracking	Real-time attendance logs synced to payroll
Leave Management	Leave request submission, approval/rejection workflow, leave balance tracking, and leave history	Approved leaves integrated with payroll calculations
Training Management	Training program creation, employee enrollment, training schedules, and certification tracking	Updated skill matrix and learning records
Performance Evaluation	Goal setting, periodic reviews, rating systems, feedback collection, and performance history	Performance data linked to payroll and promotion decisions

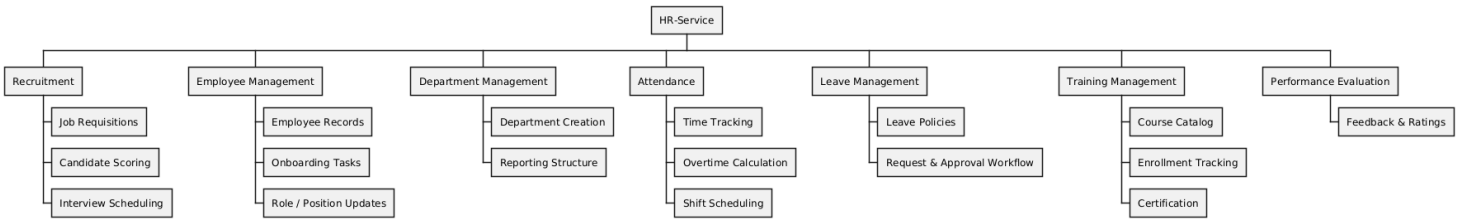

Figure 6: HR Hierarchy Diagram

4 Finance Module Architecture

The **Finance Service** manages all financial operations including payroll, expenses, and financial reporting. The service automatically calculates payroll based on attendance data, performance metrics, and configured deductions, ensuring accurate and timely salary processing.

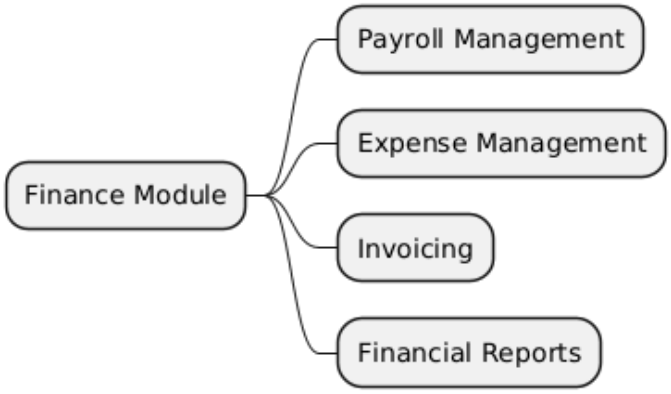

Figure 7: Finance-MindMap

Table 2: Finance Sub-Modules Overview

Sub-Module	**Description**
Payroll Management	Automatically calculates salaries using attendance, performance data, bonuses, and deductions. Supports multiple payment periods and account configurations.
Expense Management	Records and tracks organizational and departmental expenses with approval workflows. Supports bulk import via CSV/Excel files.
Invoicing	Handles client and vendor billing with automated invoice generation, status tracking (DRAFT, SENT, PAID), and payment management.
Financial Reports	Provides dashboards and summaries of budgets, expenditures, profitability, and financial trends.

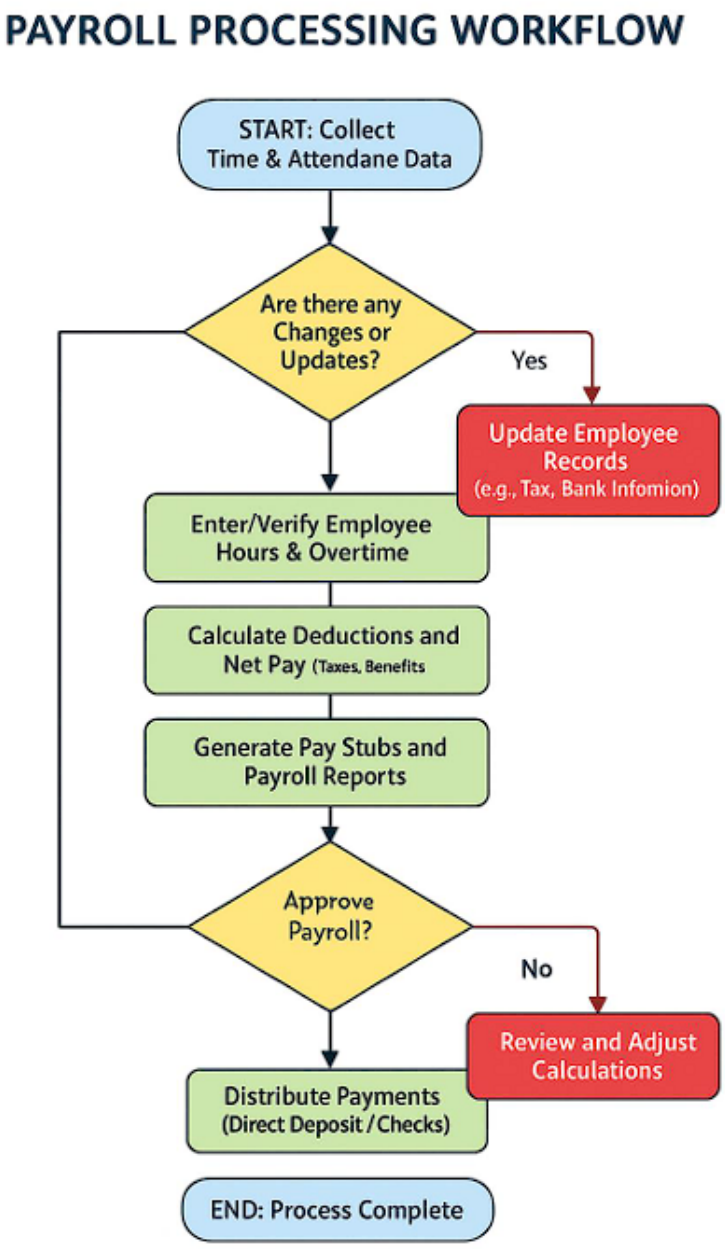

Figure 8: Payroll Process Workflow

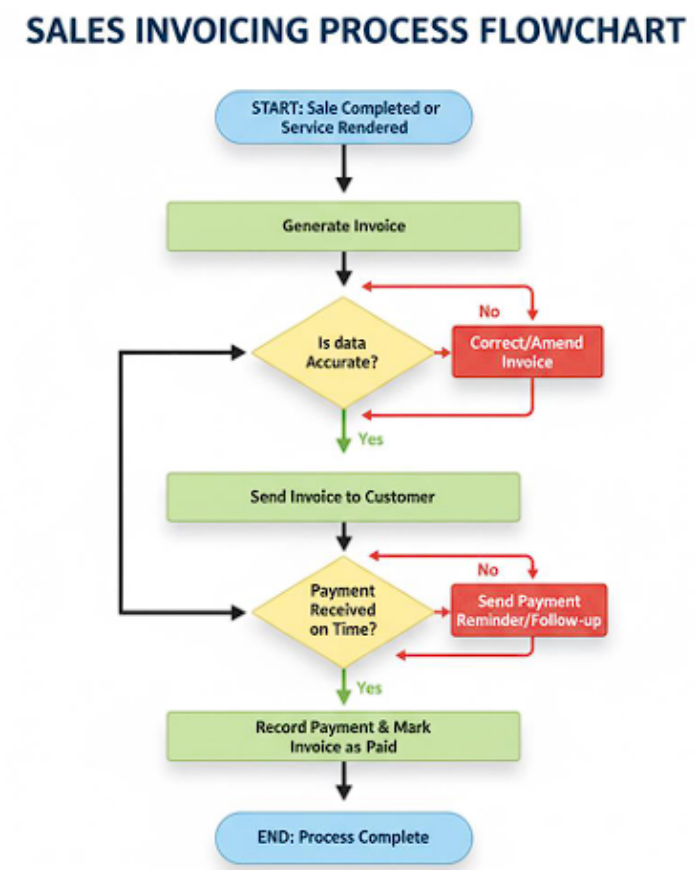

Figure 9: Sales Invoicing Process Workflow

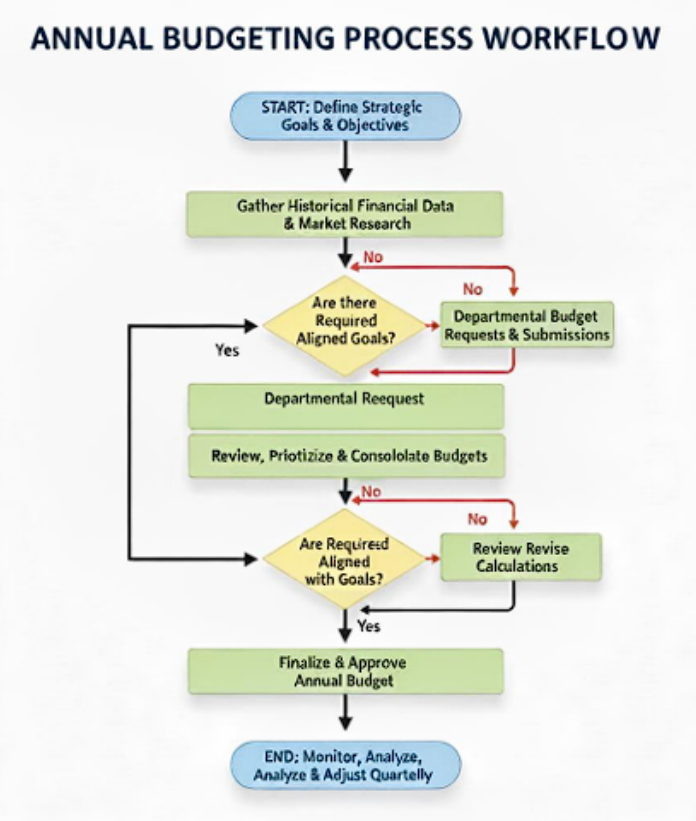

Figure 10: Annual Budgeting process workflow

5 Inventory Module Architecture

The **Inventory Service** provides comprehensive inventory and stock management capabilities, enabling organizations to track items across multiple warehouses, monitor stock levels in real-time, and manage inventory movements efficiently.

5.1 Inventory Service Overview

The Inventory Service is a Spring Boot microservice that handles:

- **Item Management:** Creation and maintenance of inventory items with SKU codes, descriptions, units of measure, and reorder levels.
- **Warehouse Management:** Multi-warehouse support with location tracking and warehouse-specific stock levels.
- **Stock Tracking:** Real-time stock level calculations based on inventory movements (receipts, issues, adjustments).
- **Movement Management:** Recording of all inventory transactions including IN (receipts), OUT (issues), and ADJUST (adjustments) with reference tracking.
- **Low Stock Alerts:** Automatic identification of items below reorder levels for proactive inventory replenishment.

Table 3: Inventory Sub-Modules Overview

Sub-Module	**Description**
Item Management	Create, update, and manage inventory items with SKU, name, description, unit of measure, and reorder level configuration.
Warehouse Management	Manage multiple warehouse locations, track warehouse-specific inventory, and support warehouse transfers.
Stock Level Tracking	Real-time calculation of on-hand quantities per item and warehouse, with support for aggregate stock levels across all warehouses.
Movement Management	Record inventory movements (IN for receipts, OUT for issues, ADJUST for corrections) with quantity tracking, reference numbers, and timestamps.
Low Stock Monitoring	Automatic detection of items below reorder levels with alerts for inventory managers.

5.2 Inventory Operations

- **Stock Receipts (IN):** Record incoming inventory from suppliers, transfers, or returns.
- **Stock Issues (OUT):** Track inventory consumption, sales, or transfers out with automatic stock validation to prevent negative inventory.
- **Stock Adjustments:** Correct inventory discrepancies, handle write-offs, or account for damaged goods.
- **Multi-Warehouse Support:** Track inventory across multiple locations with warehouse-specific stock levels.
- **Stock Queries:** Query stock levels by item, warehouse, or aggregate across all warehouses.

6 Reporting Service Architecture

The **Reporting Service** is an independent ASP.NET Core microservice responsible for analytics visualization, PDF/Excel report generation, and consolidated ERP data summaries. It integrates with HR, Finance, and Inventory microservices through REST APIs to compile comprehensive business intelligence.

- **Technology Stack:** ASP.NET Core 8.0, C#, Entity Framework, SQL Server (or PostgreSQL), and RESTful APIs.
- **Integration:** Consumes endpoints from HR, Finance, and Inventory services to compile data for dashboards and exports.
- **Output Formats:** Interactive dashboards, downloadable PDF reports, and Excel summaries with customizable templates.
- **Access Control:** Only Admins and Managers can generate organization-wide reports; HR, Finance, and Inventory users can generate module-specific reports.
- **Report Types:** Payroll summaries, attendance reports, financial summaries, employee reports, expense reports, and invoice reports.

Table 4: Reporting Sub-Modules Overview

Sub-Module	**Description**
Data Aggregation	Fetches data from HR, Finance, and Inventory microservices for consolidated analysis and cross-module reporting.
Report Generation	Creates PDF/Excel reports for payroll, attendance, financial summaries, employee records, expenses, and invoices with customizable date ranges and filters.
Dashboard Analytics	Displays performance indicators, expense trends, productivity charts, inventory levels, and operational KPIs in real-time.
Export and Sharing	Allows exporting reports in multiple formats and sharing with Admin/HR/Finance/Inventory departments with role-based access control.

7 Functional Requirements

This section defines the functional capabilities that the Konecta ERP System must provide. Each requirement describes the expected behavior of a specific module or user interaction within the system.

7.1 Overview

The ERP system supports multiple roles — **Admin**, **HR**, **Finance**, **Inventory**, and **Employee**. Each role has a distinct set of features aligned with its operational responsibilities.

7.2 Functional Requirements Table

ID	Requirement Description	Priority	Module
FR-1	The system shall allow users to log in using username/email and password.	High	Auth
FR-2	The system shall verify credentials and issue a JWT token upon successful authentication.	High	Auth
FR-3	The system shall allow the Admin to manage users (add, update, delete, and assign roles).	High	Admin
FR-4	The HR module shall allow HR staff to register new employees and maintain employee records.	High	HR
FR-5	The HR module shall allow employees to mark daily attendance and track working hours.	High	HR
FR-6	The HR module shall allow employees to submit leave requests and HR to approve or reject them.	High	HR
FR-7	The HR module shall allow HR to evaluate employee performance and record ratings and feedback.	Medium	HR
FR-8	The HR module shall support training program management and employee enrollment.	Medium	HR
FR-9	The HR module shall manage offboarding processes including exit interviews and clearance.	Medium	HR
FR-10	The HR module shall provide AI-powered assistance for HR queries and best practices.	Low	HR
FR-11	The Finance module shall automatically calculate payroll based on attendance, performance, and deductions.	High	Finance
FR-12	The Finance module shall allow Finance staff to process expenses, including submission, review, and approval.	High	Finance
FR-13	The Finance module shall handle client and vendor invoicing and track payment statuses.	Medium	Finance
FR-14	The Inventory module shall allow Inventory staff to manage items, warehouses, and track stock levels.	High	Inventory
FR-15	The Inventory module shall record inventory movements (receipts, issues, adjustments) and prevent negative stock.	High	Inventory
FR-16	The Inventory module shall provide low-stock alerts based on reorder levels.	Medium	Inventory
FR-17	The Reporting module shall aggregate data from HR, Finance, and Inventory to generate analytical dashboards.	High	Reporting
FR-18	The Reporting module shall generate exportable reports in PDF and Excel formats.	Medium	Reporting
FR-19	The system shall restrict access to data and APIs based on JWT roles (Admin, HR, Finance, Inventory, Employee).	High	Security
FR-20	The system shall allow the Admin to view overall analytics and monitor module activity.	Medium	Admin
FR-21	The Employee portal shall display personal information, attendance, salary, and performance data.	High	Employee

FR-22	The system shall allow all modules to communicate securely with the Reporting service via REST APIs.	High	Integration
FR-23	The system shall log all critical operations (logins, approvals, and updates) for audit purposes.	Medium	Security
FR-24	The system shall provide error messages and validation feedback for all input fields.	Medium	General
FR-25	The system shall support data export for payroll summaries, employee attendance, and inventory reports.	Medium	Reporting
FR-26	The system shall provide dashboards summarizing HR, Finance, Inventory, and overall business KPIs.	High	Reporting

7.3 Functional Requirement Categories

- **Authentication and Access Control:** Secure login, token generation, and role validation.
- **Human Resources Management:** Employee data management, attendance, leave, training, performance tracking, recruitment, and offboarding.
- **Finance Management:** Payroll processing, expense tracking, and invoicing.
- **Inventory Management:** Item and warehouse management, stock tracking, and movement recording.
- **Reporting and Analytics:** Real-time dashboards, performance insights, and exportable reports.
- **Administration:** User management, monitoring, and global configuration.

8 Test Cases for Functional Requirements

This section describes the test cases that validate each functional requirement of the Konecta ERP System. Each test case specifies the input, expected output, and success criteria to ensure the requirement functions as intended.

FR ID	**Test Case Description**	**Test Input**	**Expected Output**
FR-1	Verify user login with valid credentials.	Username and password.	User is successfully logged in and redirected to dashboard.
FR-2	Validate JWT token is generated upon successful login.	Valid credentials.	JWT token issued and stored in frontend securely.
FR-3	Test Admin user management functions (add, edit, delete, assign role).	Admin account and user details.	New user created/updated/deleted successfully and reflected in Auth DB.
FR-4	Verify HR can register new employees.	HR inputs employee data.	New employee record appears in employee list and HR DB.
FR-5	Verify attendance marking and logging.	Employee clicks "Mark Attendance".	Attendance record created with timestamp and status "Present".

FR-6	Test leave request submission and HR approval/rejection.	Employee submits leave form.	Leave status changes to "Pending" → "Approved/Rejected" after HR action.
FR-7	Verify HR can record employee performance evaluation.	HR enters rating and feedback.	Performance record saved and visible in employee profile.
FR-8	Test training program creation and employee enrollment.	HR creates training program, employee enrolls.	Training program saved, enrollment recorded, and visible in employee profile.
FR-9	Verify offboarding process initiation and completion.	HR initiates offboarding for employee.	Offboarding record created, exit interview scheduled, clearance tracked.
FR-10	Test AI query functionality for HR assistance.	HR submits query to AI service.	AI response received and displayed.
FR-11	Test automatic payroll generation using attendance and performance data.	Payroll period input.	Net salary calculated and stored in payroll table.
FR-12	Validate expense management workflow.	Employee submits expense claim.	Expense recorded, pending for approval, status updates correctly.
FR-13	Verify invoicing and payment status tracking.	Finance creates new invoice.	Invoice generated, saved in database, and status updated (Paid/Unpaid).
FR-14	Test item and warehouse creation in Inventory module.	Inventory staff creates item and warehouse.	Item and warehouse records saved in Inventory DB.
FR-15	Verify inventory movement recording and stock validation.	Record IN/OUT movement.	Movement recorded, stock level updated, negative stock prevented for OUT movements.
FR-16	Test low-stock alert functionality.	Item stock falls below reorder level.	Low-stock alert generated and visible to Inventory managers.
FR-17	Test report aggregation from HR, Finance, and Inventory services.	Request analytics report.	Data successfully fetched from all services and displayed in dashboard.
FR-18	Validate PDF/Excel report export function.	Admin clicks "Export Report".	File successfully generated and downloaded.
FR-19	Verify access control for each role (Admin, HR, Finance, Inventory, Employee).	Login using each role.	Restricted modules accessible only to authorized roles.
FR-20	Check Admin dashboard monitoring and analytics.	Admin login.	Dashboard displays live KPIs and user activity logs.
FR-21	Test employee self-service features.	Employee login.	Employee views personal attendance, salary, and performance data.

FR-22	Validate secure communication between all services and Reporting service.	API call between services.	Encrypted REST response received with valid JWT verification.
FR-23	Test system logging for major operations.	Perform create/update/delete actions.	Log entry stored in system log file or DB with timestamp.
FR-24	Check form input validation and error handling.	Submit form with invalid fields.	Proper error message displayed (e.g., "Invalid Email").
FR-25	Test data export for payroll summaries, attendance logs, and inventory reports.	Admin clicks export button.	CSV/XLS file generated containing requested data.
FR-26	Verify dashboard KPIs for HR, Finance, Inventory, and overall performance.	Open analytics dashboard.	Metrics displayed correctly with up-to-date data.

8.1 Test Execution Notes

- All test cases should be executed on the staging environment before production deployment.
- JWT tokens must be validated in every API call to ensure secure communication.
- Testing tools such as **Postman** and **JUnit** are recommended for backend verification.
- **Manual UI testing** should be performed for dashboard features and form validation.
- Test results must be documented with "Pass" or "Fail" outcomes and attached screenshots when applicable.

9 Security Architecture

Table 7: Security Layers and Features

Security Component	**Description**
Authentication	JWT token-based authentication using Spring Security across all microservices.
Authorization	Role validation for Admin, HR, Finance, Inventory, and Employee with fine-grained access control.
Encryption	Data encrypted in transit (SSL/TLS) and at rest using PostgreSQL encryption.
Password Protection	All user passwords hashed using BCrypt with salt rounds for maximum security.
API Security	API Gateway enforces authentication and rate limiting before routing requests to microservices.
Incident Response	Logging, alerting, and monitoring of security events across all services.

10 Role Policies and User Flows (JWT-based)

This ERP system implements authentication using **JSON Web Tokens (JWT)**. Each user logs in and receives a signed token that identifies their role (`ADMIN`, `HR`, `FINANCE`, `INVENTORY`, or `EMPLOYEE`). Spring Security annotations such as `@PreAuthorize("hasRole('HR')")` enforce what each user can access at the API level.

10.1 Role Access Summary

Table 8: Role Access Policies

Role	What They Can See	What They Can Do	Example APIs
Admin	All dashboards (HR + Finance + Inventory + Employee data)	Manage users, approve HR/Finance actions, access all reports, manage inventory	`/api/auth/*`, `/api/hr/*`, `/api/finance/*`, `/api/inventory/*`
HR	Employee records, attendance, leaves, training, performance, recruitment, offboarding	Add/update employees, approve/reject leaves, manage training, record performance, handle recruitment	`/api/hr/employees`, `/api/hr/attendance`, `/api/hr/leaves`, `/api/hr/training`, `/api/hr/performance`
Finance	Payroll, expenses, and invoices	Process payroll, manage expenses, generate financial reports, handle invoicing	`/api/finance/payroll`, `/api/finance/expenses`, `/api/finance/invoices`
Inventory	Items, warehouses, stock levels, and movements	Manage items and warehouses, record movements, view stock levels, handle low-stock alerts	`/api/inventory/items`, `/api/inventory/warehouses`, `/api/inventory/movements`, `/api/inventory/stock`
Employee	Personal dashboard (attendance, leave, salary, performance, training)	Mark attendance, request leave, view salary, view performance, enroll in training	`/api/hr/attendance`, `/api/hr/leaves`, `/api/finance/payroll/me`, `/api/hr/training`

10.2 Access Control Policy Table

Table 9: API Access Control Summary

API Prefix	Accessible By	Description
`/api/auth/*`	Admin	User and authentication management
`/api/hr/employees*`	HR, Admin	Employee CRUD operations
`/api/hr/attendance*`	HR, Employee	Attendance management
`/api/hr/leaves*`	HR, Employee	Leave requests and approvals
`/api/hr/training*`	HR, Employee	Training program management and enrollment
`/api/hr/performance*`	HR, Admin	Performance evaluations
`/api/hr/offboarding*`	HR, Admin	Offboarding process management
`/api/hr/ai/*`	HR, Admin	AI-powered HR assistance
`/api/finance/payroll*`	Finance, Admin	Payroll processing
`/api/finance/expenses*`	Finance, Admin	Expense management
`/api/finance/invoices*`	Finance, Admin	Invoice management
`/api/inventory/items*`	Inventory, Admin	Item management
`/api/inventory/warehouses*`	Inventory, Admin	Warehouse management
`/api/inventory/movements*`	Inventory, Admin	Inventory movement recording
`/api/inventory/stock*`	Inventory, Admin	Stock level queries
`/api/reports/*`	Admin, HR, Finance, Inventory	Reporting endpoints

10.3 JWT Security Flow

1. User sends login credentials to `/api/auth/login`.
2. Authentication Service validates credentials and returns a JWT token.
3. The frontend stores the token securely (e.g., localStorage).
4. Each request includes the token in the `Authorization` header.
5. The API Gateway verifies the token before routing.
6. The backend checks user role claims using Spring Security.
7. Access is granted or denied based on token claims.

11 Technologies Used

Table 10: Technology Stack

Layer	**Technology**
Frontend	Angular 18, TypeScript
Backend	Spring Boot 3.5.6, Java 21
Reporting Service	ASP.NET Core 8.0, C#, Entity Framework
Database	PostgreSQL
Security	Spring Security, JWT
API Gateway	Spring Cloud Gateway
Service Discovery	Eureka Server
Configuration Management	Spring Cloud Config
Deployment	Docker, Jenkins (CI/CD)