Enterprise & Supplier Portal Documentation

1. Executive Summary

This document provides a technical and functional overview of the **SequelString Enterprise Platform**, focusing on the Finance, Operations, Audit, and Supplier Portal modules. The platform is a hybrid React-based application designed for complex logistics financial management, featuring real-time market data integration, AI-powered invoice processing, and a dual-interface architecture (Enterprise vs. Supplier).

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2. System Architecture

2.1. High-Level Architecture

The application follows a **Modular Monolith** architecture on the frontend, with a clear separation between the Enterprise Command Center and the Supplier Portal.

- **Frontend**: React (TypeScript), Tailwind CSS, Recharts, Framer Motion.
- **Backend Integration**: Hybrid Data Model.
- **Primary**: REST API calls to `http://localhost:5000` (Node.js/MySQL middleware) for persistence.
- **Fallback**: Robust local mock services (e.g., `INDIAN_SUPPLIERS` in `supplierService.ts`) ensure UI functionality without a live backend.
- **AI/ML Services**:
- **OCR**: Google Gemini 2.0 Flash for invoice extraction.
- **Simulation**: Client-side logic for Rate Simulation and Cost-to-Serve analysis.

2.2. Module Hierarchy

• **App.tsx**: Main Entry Point. Handles Routing, Authentication (`activePersona`), and Layout switching between `Sidebar` (Enterprise) and `SupplierPortalView`.
• **Enterprise Layer**
• **Operations**: `Dashboard.tsx`, `ContractManager.tsx`
• **Audit**: `InvoiceWorkbench.tsx`, `InvoiceIngestion.tsx`
• **Finance**: `FinanceDashboard.tsx`, `SettlementFinance.tsx`, `CostToServe.tsx`

- **External Layer**
- **Supplier Portal**: `SupplierPortalView.tsx`, `SupplierLogin.tsx`

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3. Module Breakdown

3.1. Enterprise: Operations ("Logistics Control Tower")

Primary Persona: Kaai Bansal (Logistics Head)

- **Dashboard (`Dashboard.tsx`)**:
- **Features**: Real-time shipment velocity charts, carrier performance scorecards, and predictive spend modeling.
- **Visuals**: Uses distinct "Solid 3D Geometric" icon set for high-impact visualization.
- **Contract Manager (`ContractManager.tsx`)**:
- **Rate Simulator**: Key feature that allows users to test "What-If" scenarios for freight rates based on vehicle type, diesel price, and distance.
- **PVC Management**: Configures Purchase Variation Clauses (Fuel Surcharges) linked to live diesel benchmarks.
- **Data**: Manages `Contract` entities with complex Freight Matrices.

3.2. Enterprise: Audit ("Freight Audit Bureau")

Primary Persona: System Admin / Auditor

- **Invoice Workbench (`InvoiceWorkbench.tsx`)**:
- **Workflow**: 3-Stage Approval Process (Logistics Approval -> Finance Review -> Admin Finalization).
- **Features**:
- **Rule Engine**: Auto-flags variances between 'TMS Est' and 'Billed Amt'.
- **ERS (Self-Billing)**: Generates invoices automatically for unbilled shipments.
- **Role-Based Filtering**: "Pending On Me" vs. "Approved By Me".
- **Invoice Ingestion (`InvoiceIngestion.tsx`)**:
- **Technology**: Google Gemini 2.0 Flash API.
- **Process**: Upload -> AI Scan -> Confidence Scoring -> Manual Verification.
- **Data Extraction**: Extracts Invoice #, Date, Vendor, Line Items (Base Freight vs. Accessorials).

3.3. Enterprise: Finance ("Global Finance Hub")

Primary Persona: Zeya Kapoor (Finance Head)

- **Finance Dashboard (`FinanceDashboard.tsx`)**:
- **Market Data**: Integrates `RapidAPI` for live Diesel Prices (Mumbai/Delhi) and simulated Freight Indices.
- **Visuals**: Ticker tapes, Live Rate cards.
- **Settlement & Treasury (`SettlementFinance.tsx`)**:
- **Payment Factory**: Manages payment batches, discount application (Early Payment), and remittance generation.
- **Bank Reconciliation**: Auto-matches ERP ledger entries with Bank Statement feeds.
- **Cash Flow**: Visualizes Inflow vs. Outflow using `Recharts`.
- **Cost To Serve (`CostToServe.tsx`)**:
- **Margin Engineering**: Simulator to adjust FTL Consolidation %, Fuel Index, and Efficiency to see impact on Profit Margins.
- **Visuals**: ISO-Metric Bar Charts (3D).

3.4. Supplier Portal

Target Users: Transport Vendors (TCI, Blue Dart, VRL)

- **Architecture**:
- **Login**: Dedicated `SupplierLogin.tsx` with demo "Quick Login" functionality.
- **View**: `SupplierPortalView.tsx` with independent dark-mode sidebar.
- **Key Features**:
- **Smart Invoicing**: Direct invoice upload or flip-PO-to-Invoice.
- **Live Operations**: Real-time tracking of assigned shipments.
- **Payments**: Visibility into approved invoices and expected payment dates.
- **Notification Hub**: Real-time alerts for disputes, rate re-negotiations, and payment releases.

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4. Data Flow & Integration

4.1. The Invoice Lifecycle

```mermaid
graph TD
A[Supplier Portal] -->|Upload PDF| B(Invoice Ingestion)
B -->|Gemini AI| C{Confidence Check}
C -->|Low Score| D[Manual Verification]
C -->|High Score| E[Invoice Workbench]
D --> E
E -->|Validation| F{Audit Checks}
F -->|Variance > Threshold| G[Exception / Dispute]
F -->|Clean| H[Logistics Approval]
H -->|Ops Approved| I[Finance Review]
I -->|Payment Scheduled| J[Settlement Module]
J -->|Remittance Advice| K[Supplier Portal]
```

4.2. Service Layer Integration

- **`supplierService.ts`**: The backbone of the Supplier Portal. Handles fetching profile data, documents, and syncing notifications. Implements the "Hybrid" fetch logic.
- **`financeDataService.ts`**: Acts as the external gateway.
- **Input**: RapidAPI (Diesel), Static Simulators (Freight Index).
- **Output**: Unified Market Data Object used by Dashboards and Contract/Cost simulators.
- **`contractService.ts`**: The detailed pricing engine. Calculates `Total Cost = (Base Rate * Distance) + (Fuel Surcharge * PVC Factor) + Accessorials`.

4.3. Data Persistence

- **Local Storage**: Used effectively for demo persistence (simulating state reliability during a session).
- **MySQL Sync**: Critical actions (Notifications, Invoice Status Changes) attempt to write to the backend `api/notifications/send` or `api/vendors` to ensure enterprise-grade persistence.

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5. Technical Dependencies

- **UI/UX**: `lucide-react` (Icons), `recharts` (Analytics), `framer-motion` (Animations).
- **AI**: `@google/generative-ai` (OCR).

- **Utils**: `jspdf` / `jspdf-autotable` (PDF Report Generation), Custom CSV Exporters.