LoanDocs: Technical Architecture & System Design

This section details the technical underpinnings of the LoanDocs system, showcasing the architectural patterns and .NET capabilities used to build a robust, scalable, and secure enterprise application.

1. Core Technology Stack

- **Frontend & Application Layer:** C# .NET (WinForms)
- **Data Layer:** MS Access (for branch-level data persistence)
- **Deployment & Update:** ClickOnce Technology
- **Data Serialization:** SOAP Format

2. Object-Oriented Domain Model & Hierarchical UI

The system is built on a sophisticated, object-oriented domain model that perfectly mirrors the real-world loan structure.

- **Root Object - Sanction:** The top-level object representing the entire loan sanction.
- **Composition & Collections:** Each Sanction contains collections of:
    - **Borrowers & Guarantors**
    - **Facilities** (individual loan components)
    - **Securities** (of various types: Vehicle, Real Estate, Machinery, Inventory, etc.)
    - **Documents**
- **Intuitive User Interface:**
  A **TreeView control** visually represents this object hierarchy, allowing users to navigate complex loan structures intuitively. Selecting a node in the tree (e.g., a specific Security) automatically displays its properties in an accompanying **Property Grid** for data entry.

3. Advanced Data Management & Persistence

To ensure both performance and data integrity, a dual-persistence strategy was implemented:

- **Persistence Mechanism:** The in-memory object instances (the entire Sanction graph) are serialized into a **SOAP (Simple Object Access Protocol)** format.
- **Dual Storage for Redundancy:**
    1. **Disk File:** The SOAP block is saved to a local file for quick access and robustness.
    2. **Database (Memo Field):** The same SOAP block is stored in a Memo field within the MS Access database, ensuring the data is captured in the central branch record.

4. Dynamic System Features via .NET Reflection

The system extensively uses **.NET Reflection** to create a dynamic and maintainable codebase, avoiding hard-coded configurations.

- **Generic Data Entry Layer:** The Windows **Property Grid** control serves as a universal data entry form. Reflection is used to automatically discover and display the properties of any selected object (e.g., a DwellingUnit security), complete with data type validation and grouping, eliminating the need for hundreds of custom forms.
- **Dynamic Document Generation ("Document Template Designer"):**
    - A template engine, similar to **Handlebars**, was created.
    - Template designers can insert placeholders that map directly to object properties (e.g., {{Borrower.Primary.FullName}} or {{Facility[0].Amount}}).
    - Complex custom functions provide handling of complex logic that show paragraphs which is not available with Handlebars
    - **Reflection is used at runtime** to resolve these placeholders, navigating the object graph to inject the live data into the final Word document.

5. Security, Compliance & Workflow Enforcement

The architecture includes several layers to enforce business rules and security.

- **Document Completion Control:** The system parses templates and displays required fields as a checklist of hyperlinks. **Printing is disabled until all mandatory fields are populated**, preventing incomplete documents.
- **Secure Document Viewing & Printing:**
    - A custom document viewer renders the final document for preview, **disabling copy/paste and editing** to prevent tampering.
    - Final printing is orchestrated through a **hidden instance of MS Word**, ensuring fidelity to the intended legal format.
- **Branch Synchronization:** The application was designed to work seamlessly over a **shared database on a local area network (LAN)** within each bank branch.
- **Centralized Management:**
    - **ClickOnce Deployment** allowed for seamless, automatic updates across thousands of branch PCs, even for users without administrative rights.
    - **Interest Rates** were fetched dynamically from a central server, ensuring consistency across the entire bank.