SecureDocs

“ Comprehensive Details ”

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Introduction

Purpose

SecureDocs is a Flask-based web application developed to provide a secure, centralized platform for document management. It addresses the challenge of securely storing and sharing sensitive documents by implementing AES-256 encryption, OpenSSL-based digital signatures, and HMAC for integrity verification. The application enhances security through robust authentication mechanisms, such as Two-Factor Authentication (2FA) and Single Sign-On (SSO), and supports role-based access control to differentiate between regular users and administrators. SecureDocs aims to ensure data confidentiality, integrity, and authenticity while offering a modern, user-friendly interface.

Definitions

- **User**: An individual who can register, log in, and perform actions such as uploading, downloading, verifying, and managing documents.
- **Admin**: A user with elevated privileges to manage other users, view audit logs, and oversee system operations.
- **File**: A document uploaded to the system, encrypted with AES-256, signed with OpenSSL, and stored with metadata.
- **Audit Log**: A record of user actions (e.g., login, file upload) maintained for security and compliance.
- **2FA**: Two-Factor Authentication using Time-based One-Time Passwords (TOTP) for additional login security.
- **SSO**: Single Sign-On, enabling authentication via external providers like Okta, Google, or GitHub.
- **JWT**: JSON Web Tokens used for secure session management.

Goals and Objectives

- User Goals:
    - Securely upload, store, and share documents with encryption and digital signatures.
    - Easily manage personal profiles and access files with confidence in their integrity.
- System Objectives:
        - Provide robust security through encryption, digital signatures, and authentication mechanisms.
        - Ensure accountability with detailed audit logs.
        - Deliver a responsive, intuitive interface compatible with desktop and mobile devices.

Plan

- **Phase 1: Requirement Gathering and Problem Analysis**: Identify user needs and security requirements.
- **Phase 2: UI/UX and Database Design**: Design the interface and database schema.
- **Phase 3: Front-End and Back-End Development**: Build the application components.
- **Phase 4: Security and Performance Testing**: Validate security features and optimize performance.
- **Phase 5: Deployment and Maintenance**: Launch the application and provide ongoing support.

Requirements

User Requirements

- Authentication:
    - Register and log in using email and password, with optional 2FA setup.
    - Log in via SSO using providers like Okta.
- File Management:
    - Upload files (e.g., .pdf, .docx, .txt), which are encrypted and signed.
    - Download, verify integrity/authenticity, and delete files.
- Profile Management:
    - Update personal details (e.g., name, email, password).

- Admin Functions:
    - Add, edit, or delete users and assign roles.
    - View audit logs to monitor system activity.

System Requirements

- Functional Requirements:
    - Secure authentication with 2FA (PyOTP) and SSO (Authlib).
    - File encryption using AES-256, digital signatures with OpenSSL, and HMAC for integrity.
    - Role-based access control distinguishes Users and Admins.
    - Real-time audit logging for actions like login, file upload, and user management.
- Non-Functional Requirements:
    - **Security**: Implement HTTPS, input sanitization, CSRF protection, and secure headers.
    - **Performance**: Handle file operations and database queries efficiently for up to 1,000 concurrent users.
    - **Usability**: Provide a responsive UI with glassmorphism design and intuitive navigation.

Software Development Process

Software Process Model

SecureDocs was developed using an Agile methodology, featuring 2-week sprints with iterative development and regular feedback to ensure alignment with security and usability goals.

Phases of Development

1. Specification Phase:
    - Conducted stakeholder interviews to define requirements.
    - Created user stories focusing on secure file management and authentication.
2. Design Phase:
    - Developed UI prototypes with a glassmorphism aesthetic using tools like Figma.
    - Designed a database schema for users, files, audit logs, and password reset tokens using SQLite.
3. Implementation Phase:
    - Built the front-end with Flask templates, Jinja2, Bootstrap, and custom CSS.
    - Developed the back-end using Flask, SQLAlchemy, and Flask-Login.
4. Validation Phase:

- Performed unit testing on encryption, authentication, and file operations.
- Conducted integration testing and security audits to ensure system integrity.

5. Evolution Phase:
   - Planned post-deployment updates based on user feedback, such as additional SSO options.

Architectural Design

System Architecture

SecureDocs adopts a three-tier architecture:

1. **Presentation Layer**: Flask templates with Jinja2, styled using Bootstrap and glassmorphism CSS for a modern UI.
2. **Business Logic Layer**: Flask routes handle authentication, file operations, and user requests.
3. **Data Layer**: SQLite database (with potential for PostgreSQL in production) managed via SQLAlchemy ORM.

Application Architecture

The MVC (Model-View-Controller) pattern was used:

- **Model**: SQLAlchemy models (User, File, AuditLog, PasswordResetToken) for data management.
- **View**: Jinja2 templates render the UI for users.

- **Controller**: Flask routes processing inputs, interacting with models, and updating views.

Design & Implementation

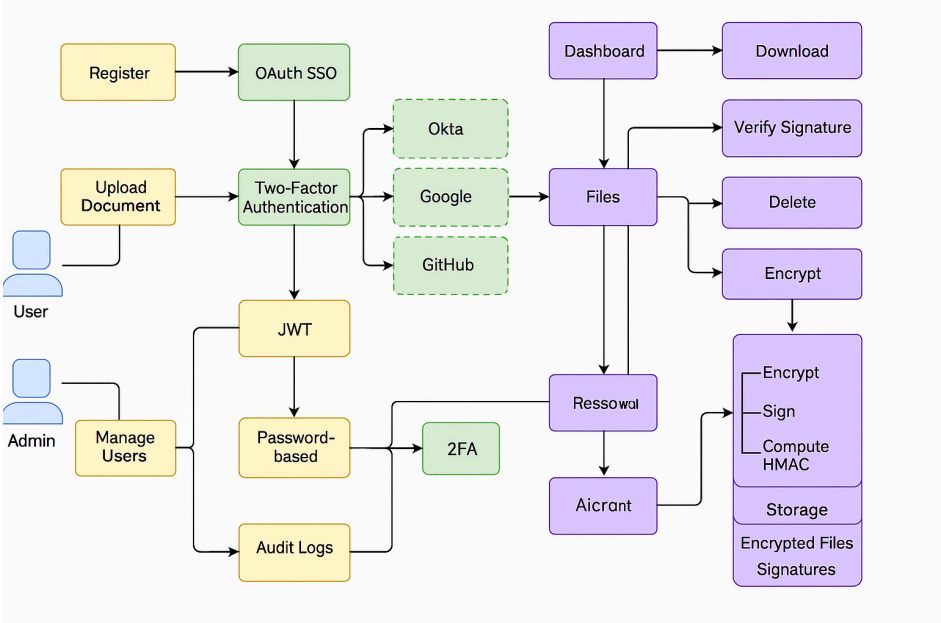
Design Description

- Front-End:
  - Responsive Flask templates using Bootstrap, enhanced with glassmorphism CSS and animations (GSAP, Animate.css).
  - Features include drag-and-drop uploads, file previews, and modal interactions.
- Back-End:
  - Flask routes for authentication, file management, and admin functions.
  - SQLAlchemy for database operations, with AES-256 encryption and OpenSSL signatures for files.

Development Environment

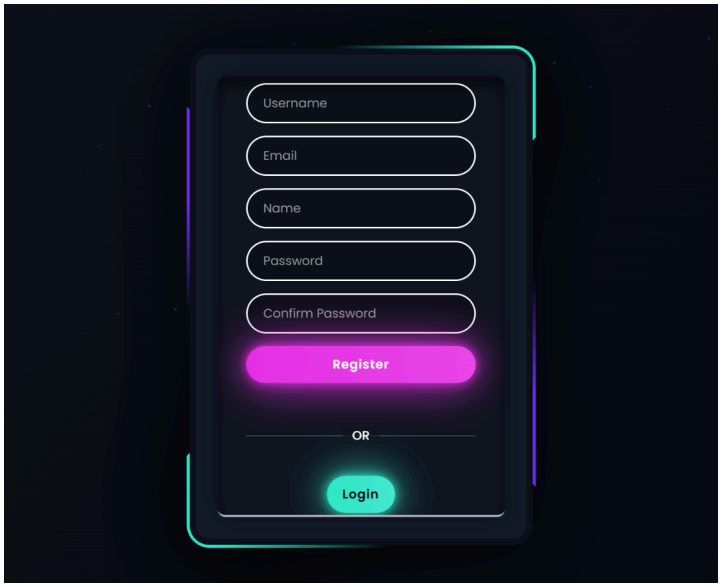
- **IDE**: Visual Studio Code.
- **Database**: SQLite (development), with potential PostgreSQL for production.
- **Tools**: Git for version control, Flask, SQLAlchemy, Flask-Login, PyOTP (2FA), Authlib (SSO).

Flow Explanation



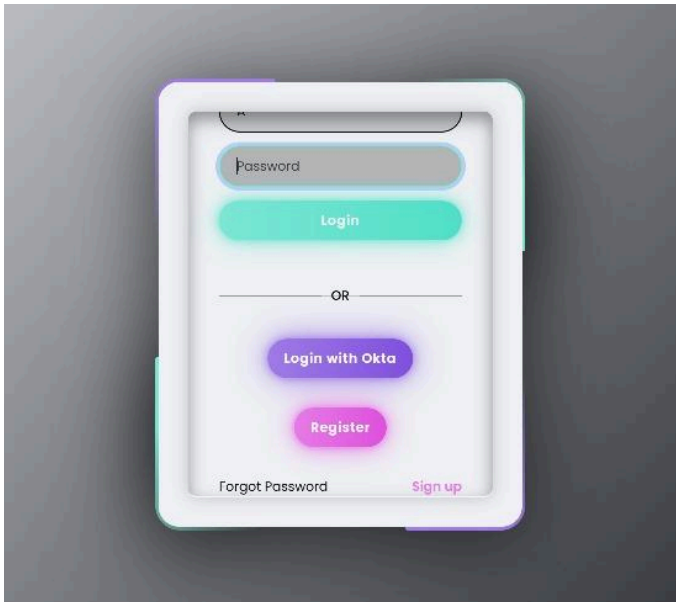
Getting Started: Signing Up and Logging In

- Sign Up:



1. A new user provides a username, email, name, and password.
2. They set up Two-Factor Authentication (2FA) by scanning a QR code with an app like Google Authenticator to add an extra layer of security.

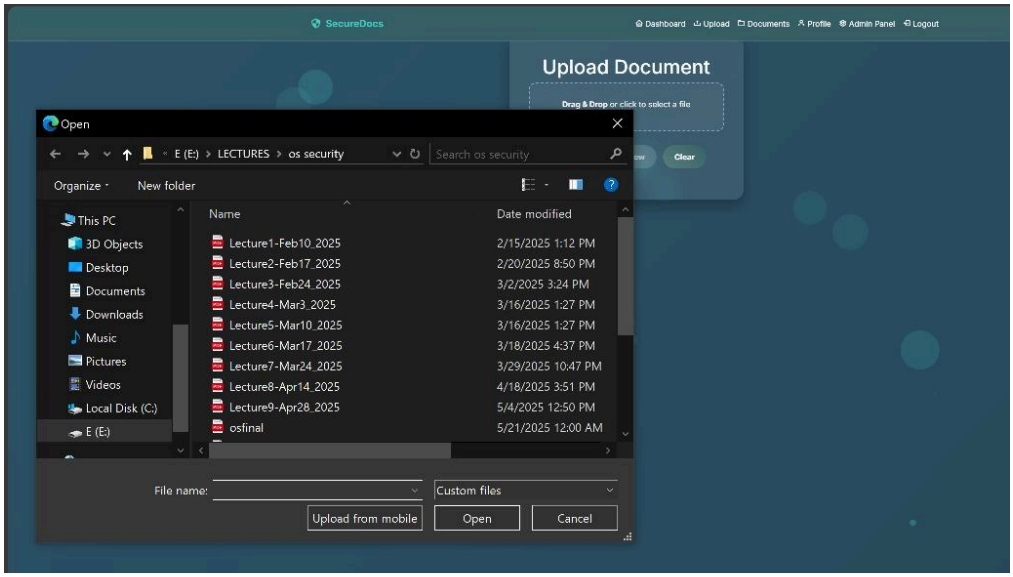
- Login:



  - The system gives the user a special token (JWT) to keep them logged in. Right now, this token expires every 30 seconds, so users may need to log in often.

Working with Files: Upload, Download, Verify, Delete

- Upload a File:

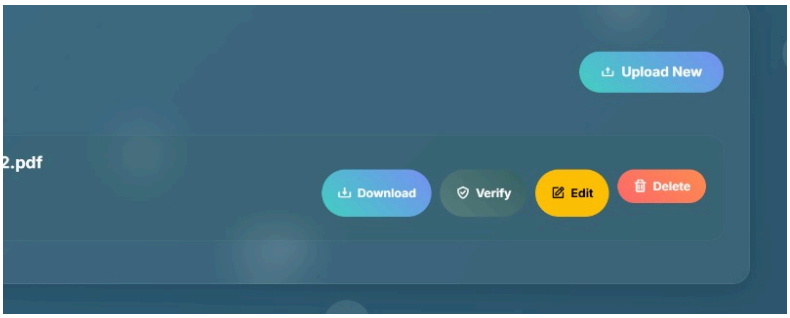


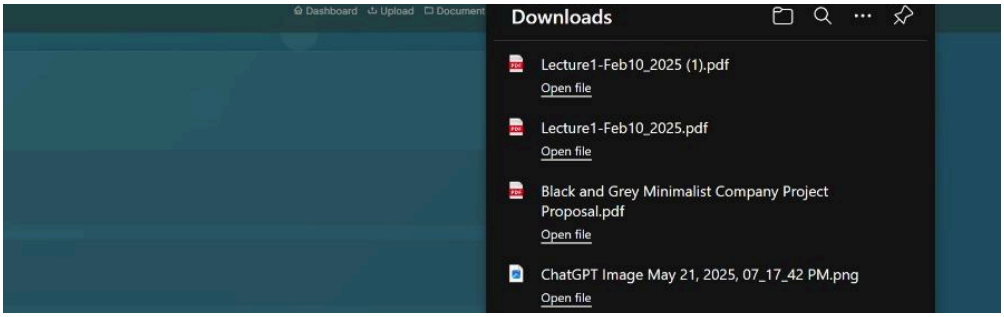
Users select a file (e.g., a PDF or Word document) and can add an optional description.

The system:

- Encrypts the file using AES-256 to keep it secure.
- Creates a digital signature to prove the file's authenticity.
- Generates an HMAC code to check if the file is altered later.
- Stores the file's details in a database and logs the upload for tracking.

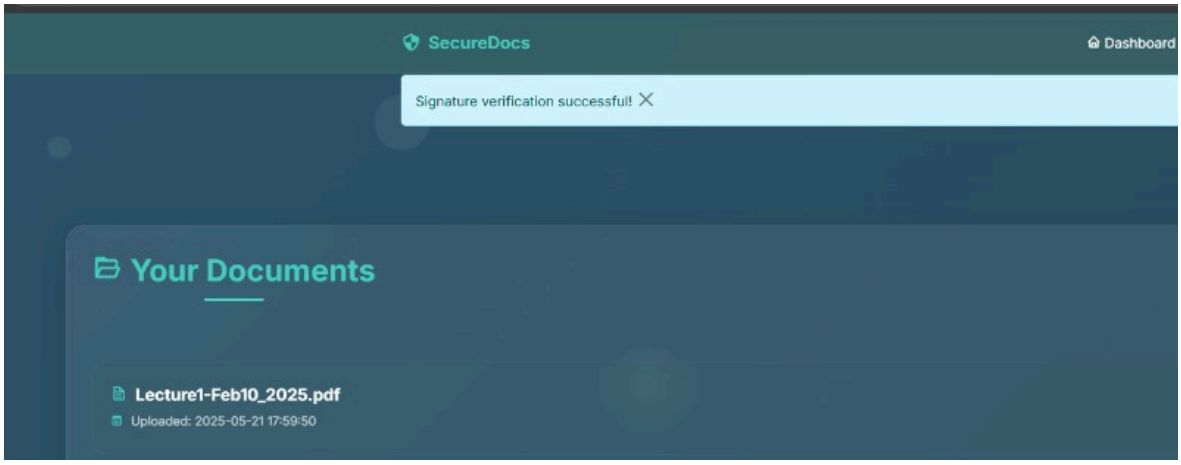
- Download a File:





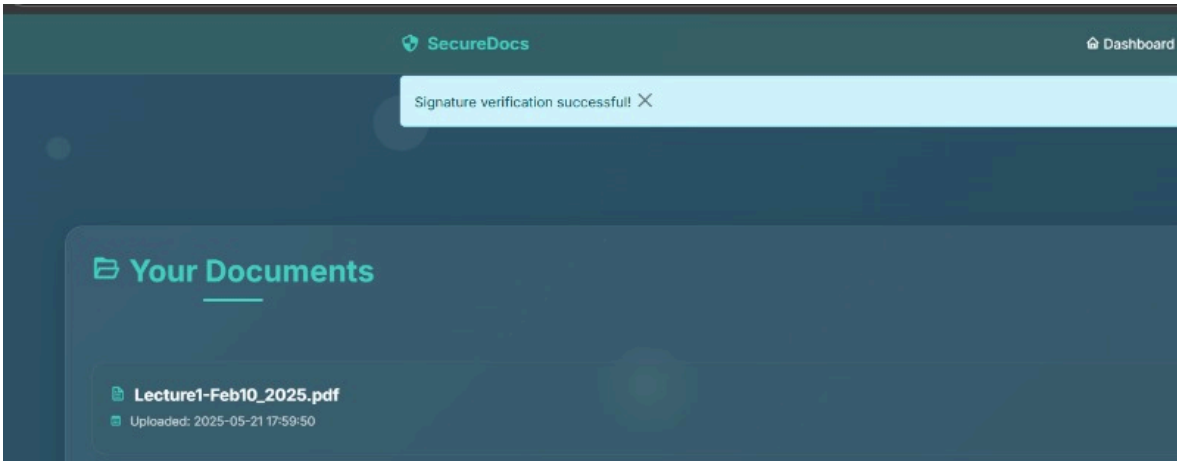
  - Users pick a file from their list.
  - The system decrypts the file, verifies its HMAC to ensure it hasn't changed, and delivers it to the user.

- Verify a File:



  - Users can check a file's digital signature to confirm it's genuine and hasn't been tampered with.

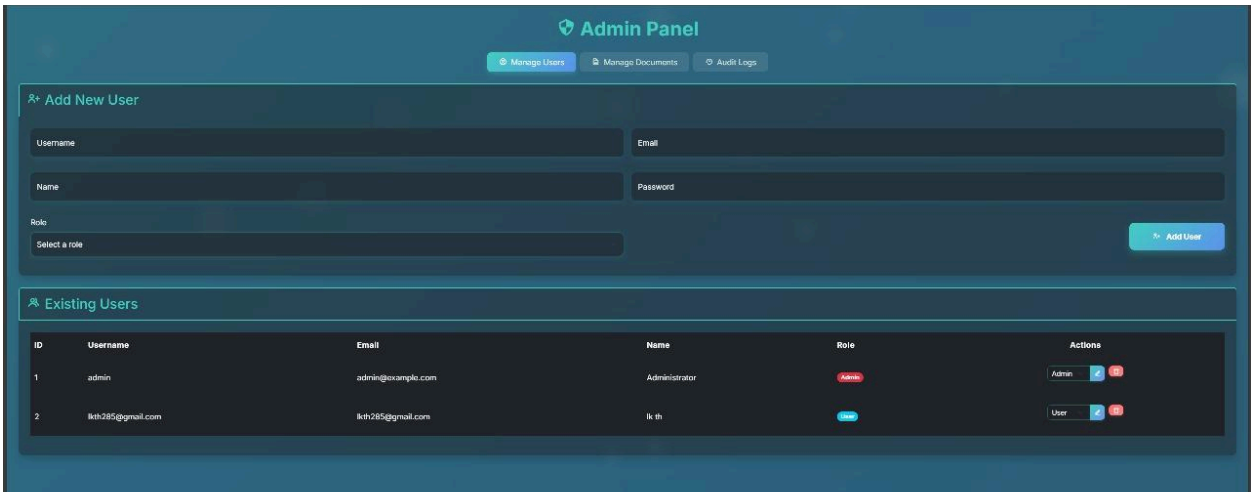
- Delete a File:



  - Users can remove a file they no longer need. The system deletes the file, its details, and logs the action.

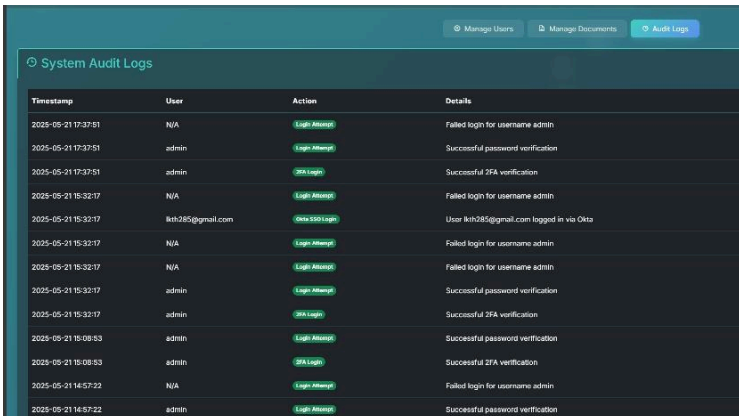
Admin Responsibilities: Managing Users and Monitoring

- Manage Users:



  - Admins can edit user details, remove users, or assign roles (like making someone an admin).
  - (Note: The ability to add new users isn't fully built yet.)

- View Audit Logs:



  - Admins can review a log of all activities—like logins, uploads, or deletions—to monitor the system and ensure everything is secure.

Testing

Development Testing

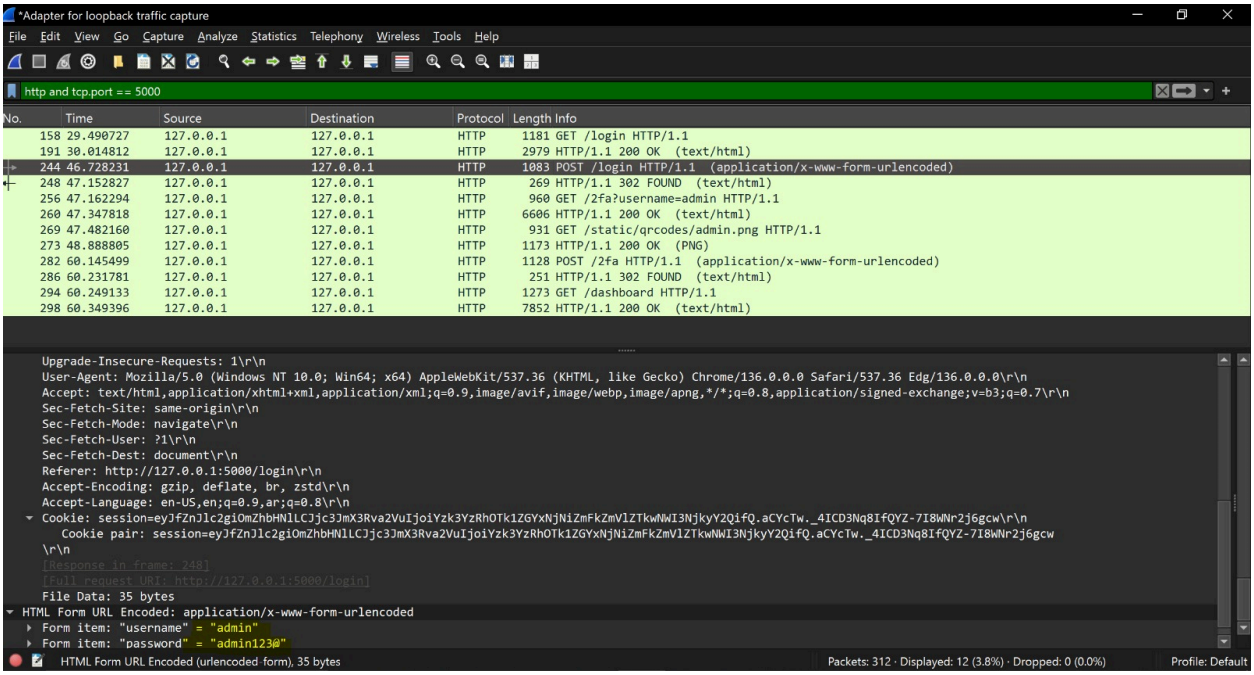
- Unit Testing:
    - Tested encryption/decryption, HMAC generation, and signature verification.
    - Verified authentication modules (password hashing, 2FA).
- Integration Testing:
    - Validated end-to-end file workflows (upload, encrypt, store, retrieve).
    - Ensured front-end and back-end synchronization.

Release Testing

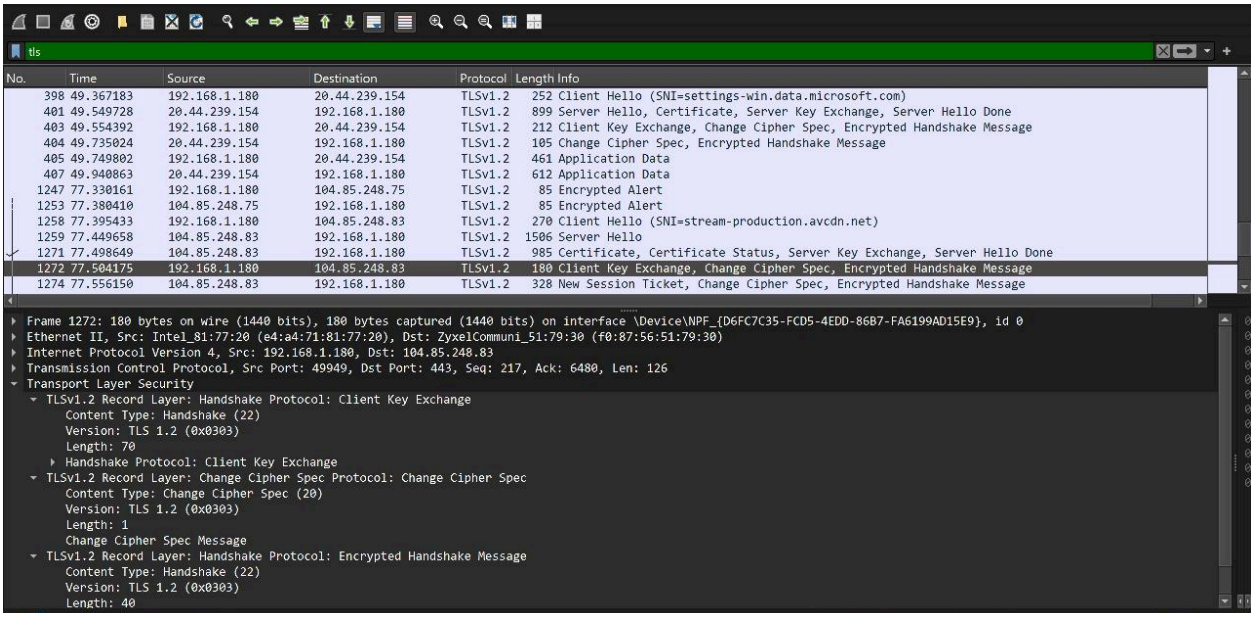
- Security Testing:
    - Conducted penetration testing with tools like OWASP ZAP to identify vulnerabilities.
    - Audited SSO and JWT implementations for secure token handling.
- Performance Testing:
    - Simulated 1,000 concurrent users to optimize file operations and query performance.

Man In The Middle

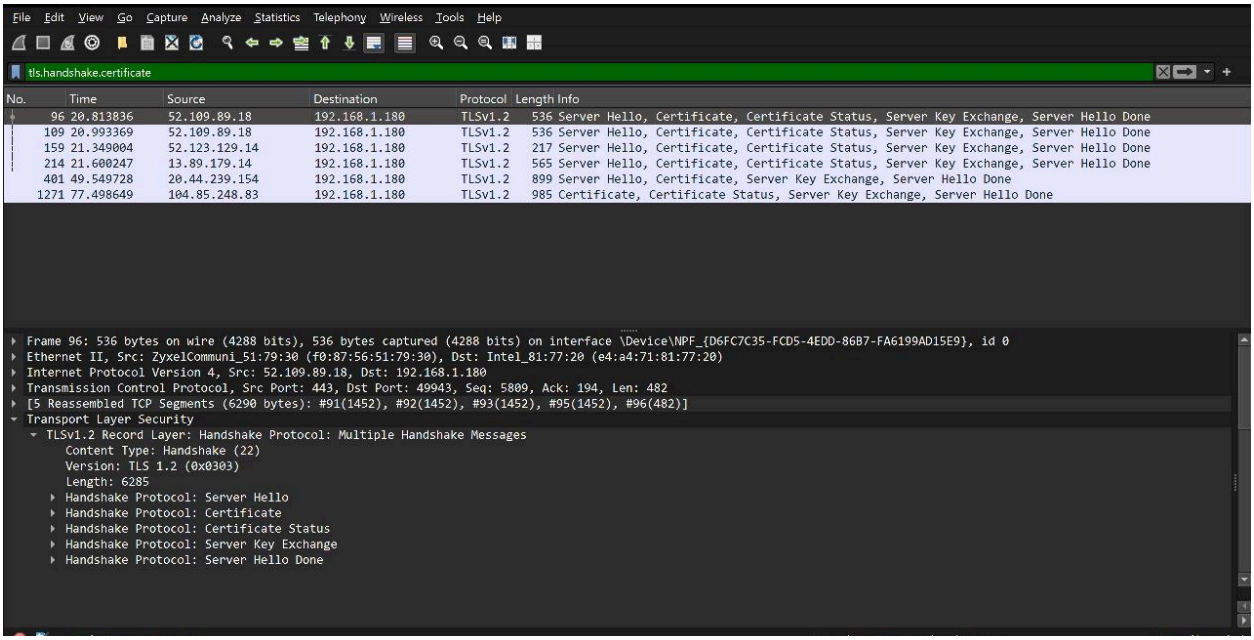
- HTTP:



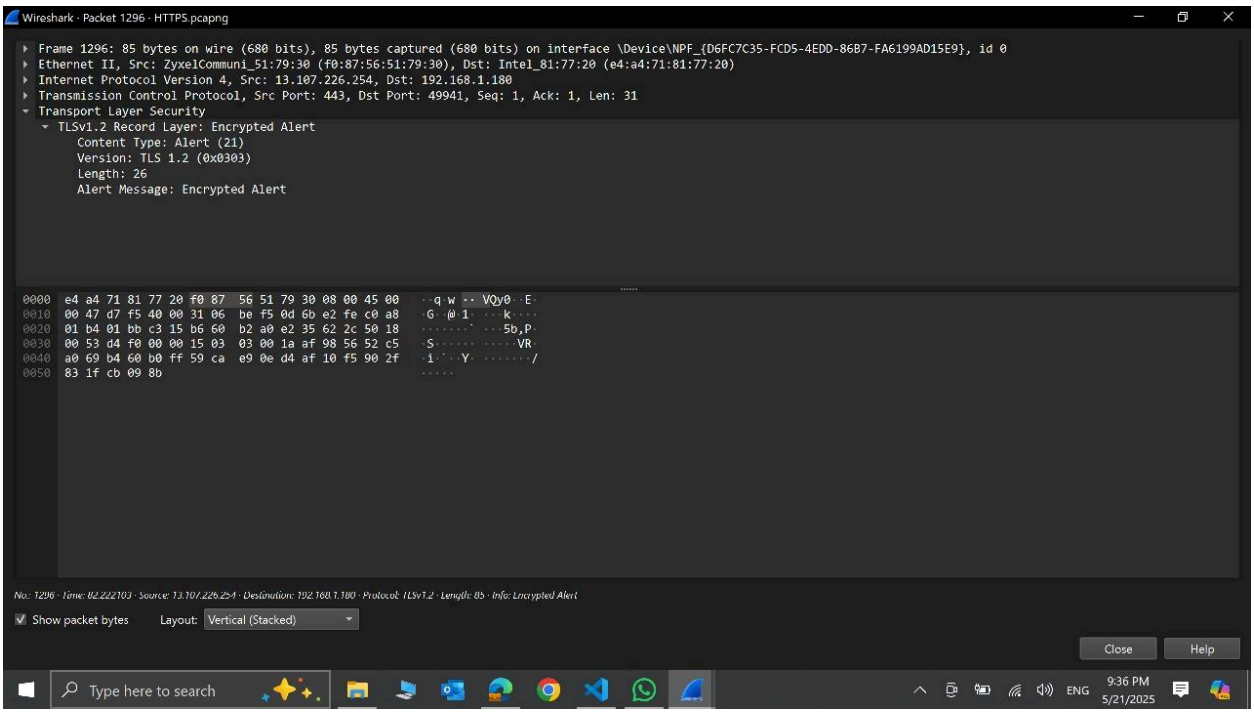
- HTTPS - Mobile to Laptop:



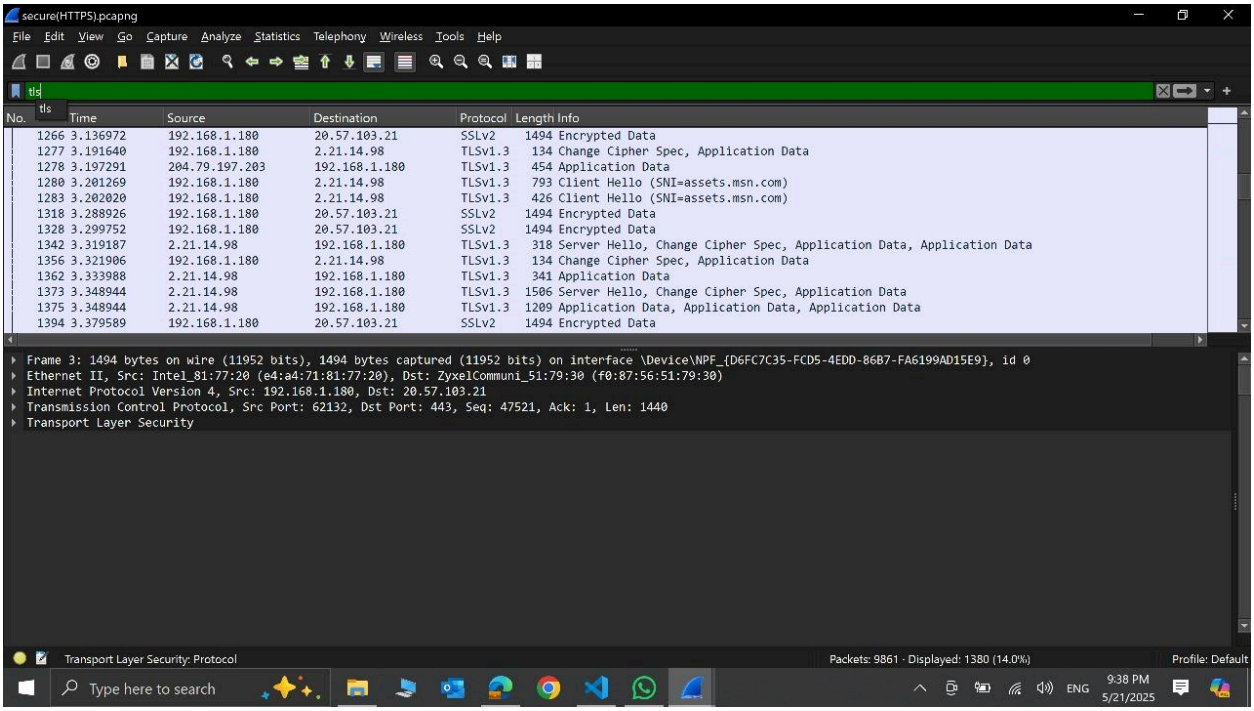
- Certificate:



- Encrypted Data:



- Local Host to Laptop:



Conclusion

SecureDocs effectively delivers a secure document management solution with encryption, digital signatures, and strong authentication. The application centralizes file handling while ensuring usability through a modern interface. However, to reach production readiness, the following improvements are recommended:

- **Missing Features**: Add routes for password reset, user management by admins, and file editing.
- **Security Fixes**: Replace hardcoded keys with a key management system and extend JWT expiration.
- **UI Consistency**: Standardize templates (e.g., register.html, reset_password.html) and remove redundant code.

Future enhancements could include additional SSO providers, file versioning, and scalability optimizations. With these refinements, SecureDocs will fully meet its objectives of security, usability, and reliability.