System Architecture Documentation

Overview

This document describes the architecture of a modern web application system that integrates various technologies including FastAPI, Amazon S3, Kafka, PostgreSQL, and Anthropic's AI services.

Architecture Components

1. Client Layer

- **Client**: The frontend application that users interact with
- Communicates bidirectionally with the FastAPI backend server
- Supports OAuth2 authentication (appears to integrate with WhatsApp or similar messaging service)

2. API Layer

- **FastAPI**: The main backend server framework
  - Handles HTTP requests from clients
  - Manages authentication and authorization
  - Orchestrates communication between various services
  - Serves as the central hub for all system interactions

3. Storage Layer

- **Amazon S3**: Cloud object storage service
  - Stores files and media content
  - Provides download capabilities
  - Connected to the FastAPI server for file operations

4. Database Layer

- **PostgreSQL**: Primary relational database
  - Stores structured application data
  - Connected to both FastAPI and Kafka for data persistence
  - Ensures data consistency and reliability

5. Message Broker

- **Kafka**: Distributed event streaming platform
  - Handles asynchronous message processing

- Connects multiple services including:
  - PostgreSQL database
  - FastAPI server
  - Anthropic AI service
- Enables real-time data processing and event-driven architecture

6. AI Integration

- **Anthropic**: AI service integration
  - Receives messages/events from Kafka
  - Provides AI-powered features and processing
  - Likely used for natural language processing or intelligent automation

7. Development Tools

The system includes several development and testing tools:

- **Swagger**: API documentation and testing interface
- **Postman**: API testing and development tool
- **Docker**: Containerization platform for deployment

Data Flow

1. **Client ↔ FastAPI**: Bidirectional communication for user requests and responses
2. **Client → OAuth2 → FastAPI**: Authentication flow through OAuth2 provider
3. **FastAPI → S3**: File upload and retrieval operations
4. **FastAPI ↔ PostgreSQL**: Direct database operations
5. **FastAPI → Kafka**: Publishing events and messages
6. **Kafka ↔ PostgreSQL**: Database updates through message queue
7. **Kafka → Anthropic**: AI processing of messages/events

Key Features

- **Scalable Architecture**: Use of Kafka enables horizontal scaling and decoupled services
- **Cloud Storage**: Amazon S3 provides reliable and scalable file storage
- **Real-time Processing**: Kafka enables real-time event processing and streaming
- **AI-Powered**: Integration with Anthropic adds intelligent features
- **Modern API**: FastAPI provides high-performance, automatic API documentation
- **Secure Authentication**: OAuth2 integration ensures secure user authentication

Technology Stack Summary

- **Backend Framework**: FastAPI
- **Database**: PostgreSQL
- **Message Broker**: Apache Kafka
- **Cloud Storage**: Amazon S3
- **AI Service**: Anthropic
- **Authentication**: OAuth2
- **Containerization**: Docker
- **API Testing**: Swagger, Postman

This architecture represents a modern, scalable, and robust system design suitable for applications requiring real-time processing, AI capabilities, and reliable data storage.