Messaging App: Full System Documentation

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Project Goals

Objectives

The goal is to develop a secure, scalable, and feature-rich messaging platform. Key objectives include:

- Real-time messaging with end-to-end encryption.
- Multimedia sharing and voice/video calls.
- A notification system with read/delivery receipts.

Core Features

- **User Authentication**: Email-based registration and login.
- **Messaging**: Real-time one-on-one and group chats, with read receipts and message statuses.
- **Media Sharing**: Support for image, video, and document sharing.
- **Voice and Video Calls**: Secure, end-to-end encrypted calling.
- **Admin Dashboard**: Monitoring user metrics and app management.

Technology Stack

Client Side

- **Framework**: Flutter for cross-platform mobile app development.
- **Real-time Communication**: WebSockets for instant message delivery.
- **Encryption**: RSA/AES encryption to secure data during messaging.

Backend Server

- **Framework**: NestJS or Django for handling business logic and API endpoints.
- **Database**: PostgreSQL for structured data storage.
- **Cache**: Redis for session management and quick access to frequently requested data.
- **Media Storage**: Firebase Storage or Amazon S3 for storing images, videos, and other media files.

Additional Tools

- **Push Notifications**: Firebase Cloud Messaging (FCM) for real-time notifications.
- **Authentication**: Firebase Auth or custom token-based login for email-based authentication.
- **Cloud Infrastructure**: Google Cloud Platform (GCP) or AWS for hosting and scalability.

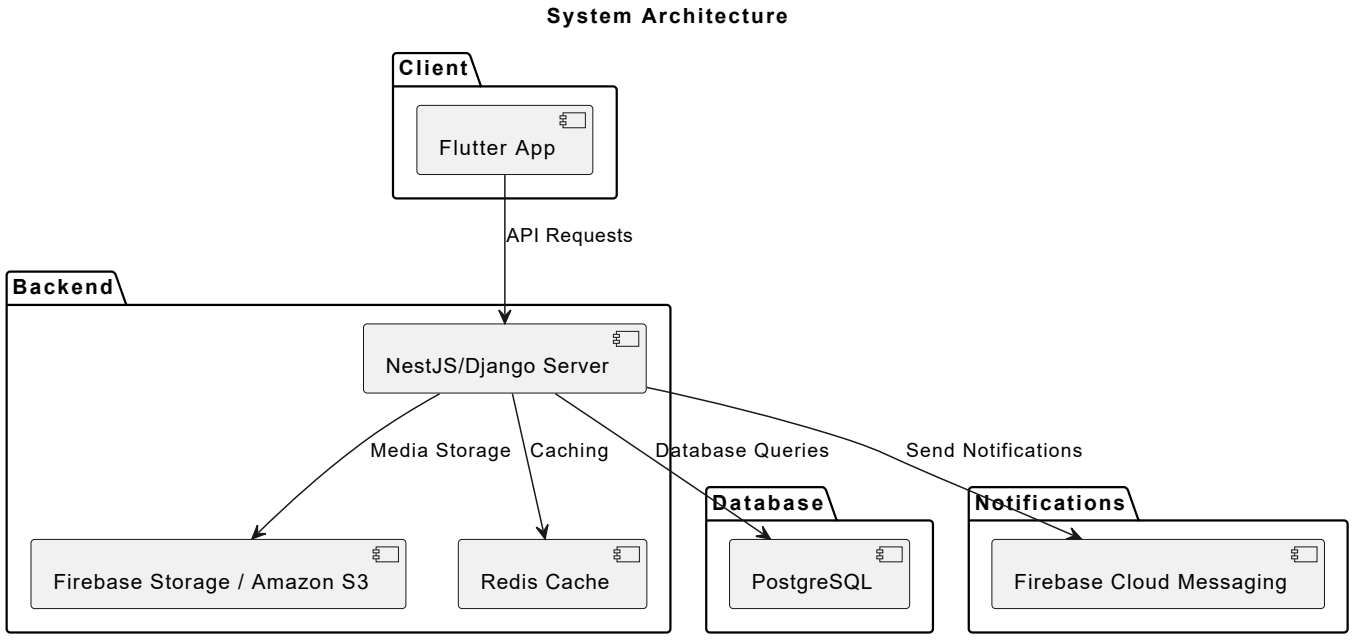
System Architecture

Overview

The system architecture consists of:

1. **Client Application**: Flutter-based app handling user interactions and real-time messaging through WebSocket connections.
2. **Backend API**: Built with NestJS or Django, this server manages user data, message routing, and API requests.
3. **Database Layer**: PostgreSQL to store structured data, with optimized indexing for search efficiency.
4. **Cache Layer**: Redis, for session management and caching frequent data, like user online status.
5. **Media Storage**: Firebase Storage or Amazon S3 for handling media uploads and secure access.
6. **Push Notification System**: Firebase Cloud Messaging to manage message notifications, calls, and other alerts.

Architecture Diagram



Database Schema

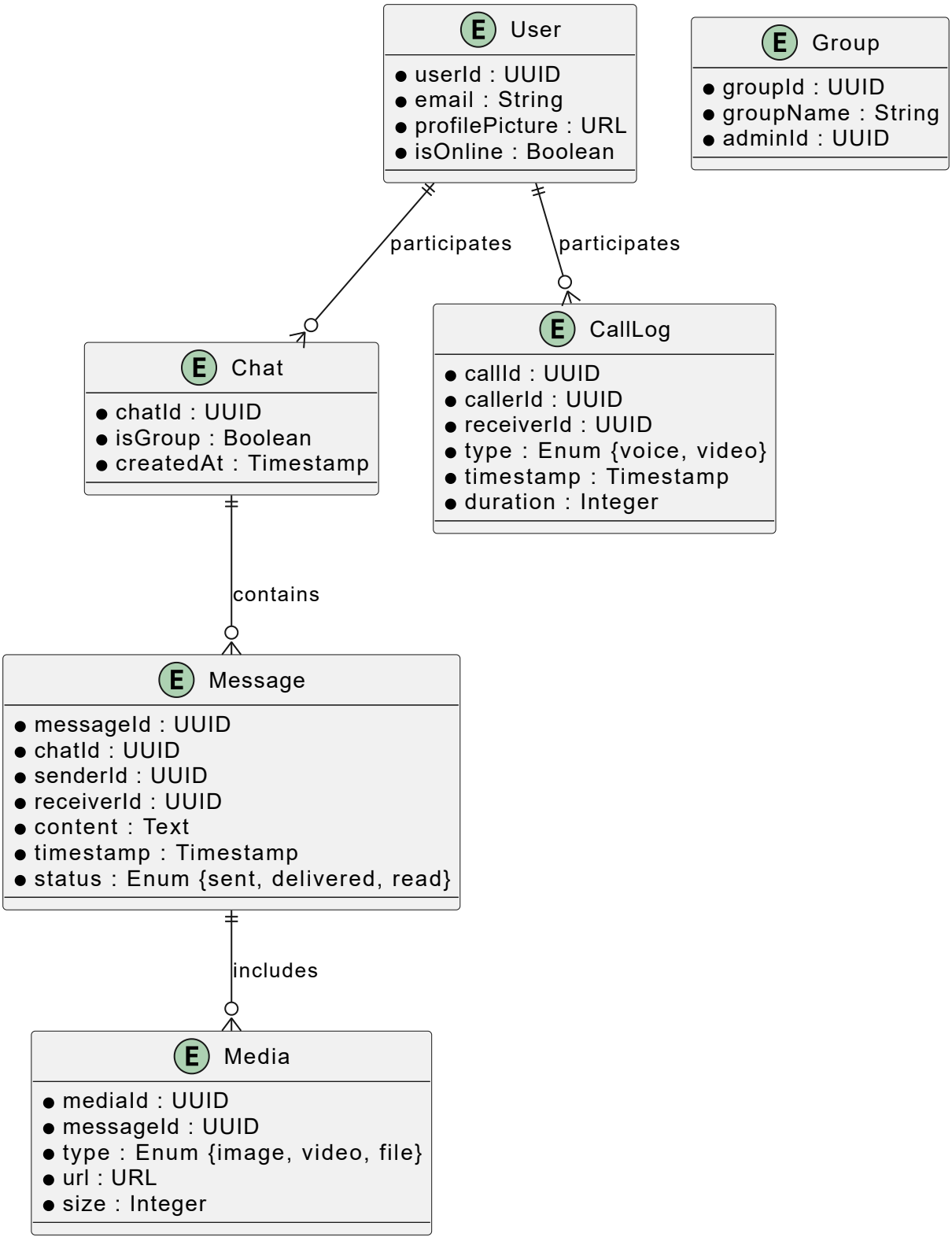
Key Entities and Relationships

1. **User**
    - Stores user information, including email, profile picture, and online status.
    - Columns: `userId`, `email`, `profilePicture`, `isOnline`.

2. **Chat**
    - Represents a conversation between users, supporting both one-on-one and group chats.
    - Columns: `chatId`, `isGroup`, `createdAt`.
3. **Message**
    - Stores individual messages, with fields for sender, recipient, content, and status (sent, delivered, read).
    - Columns: `messageId`, `chatId`, `senderId`, `receiverId`, `content`, `timestamp`, `status`.
4. **Group**
    - For group chats, with details about group members and admin.
    - Columns: `groupId`, `groupName`, `adminId`, `memberIds`.
5. **Media**
    - Stores metadata for media shared within chats.
    - Columns: `mediaId`, `messageId`, `type`, `url`, `size`.
6. **Call Log**
    - Tracks call details between users, including type and duration.
    - Columns: `callId`, `callerId`, `receiverId`, `type` (voice/video), `timestamp`, `duration`.

Entity Relationship Diagram (ERD)

Entity-Relationship Diagram



API Documentation

Authentication

Register

- **Endpoint**: `POST /api/auth/register`

- **Description**: Registers a new user using email verification.
- **Request Body**:

```
{
  "email": "user@example.com",
  "password": "securepassword"
}
```

- **Response**:

```
{
  "userId": "abc123",
  "token": "jwt_token"
}
```

Login

- **Endpoint**: `POST /api/auth/login`
- **Description**: Logs in a user and issues a JWT token.
- **Request Body**:

```
{
  "email": "user@example.com",
  "password": "securepassword"
}
```

Messaging

Send Message

- **Endpoint**: `POST /api/messages/send`
- **Description**: Sends a message from one user to another or a group.
- **Request Body**:

```
{
  "senderId": "abc123",
  "receiverId": "xyz456",
  "content": "Hello!"
}
```

- **Response**:

```
{
  "messageId": "msg789",
  "status": "sent"
}
```

Get Messages

- **Endpoint**: `GET /api/messages/{chatId}`
- **Description**: Retrieves messages for a specific chat.
- **Response**:

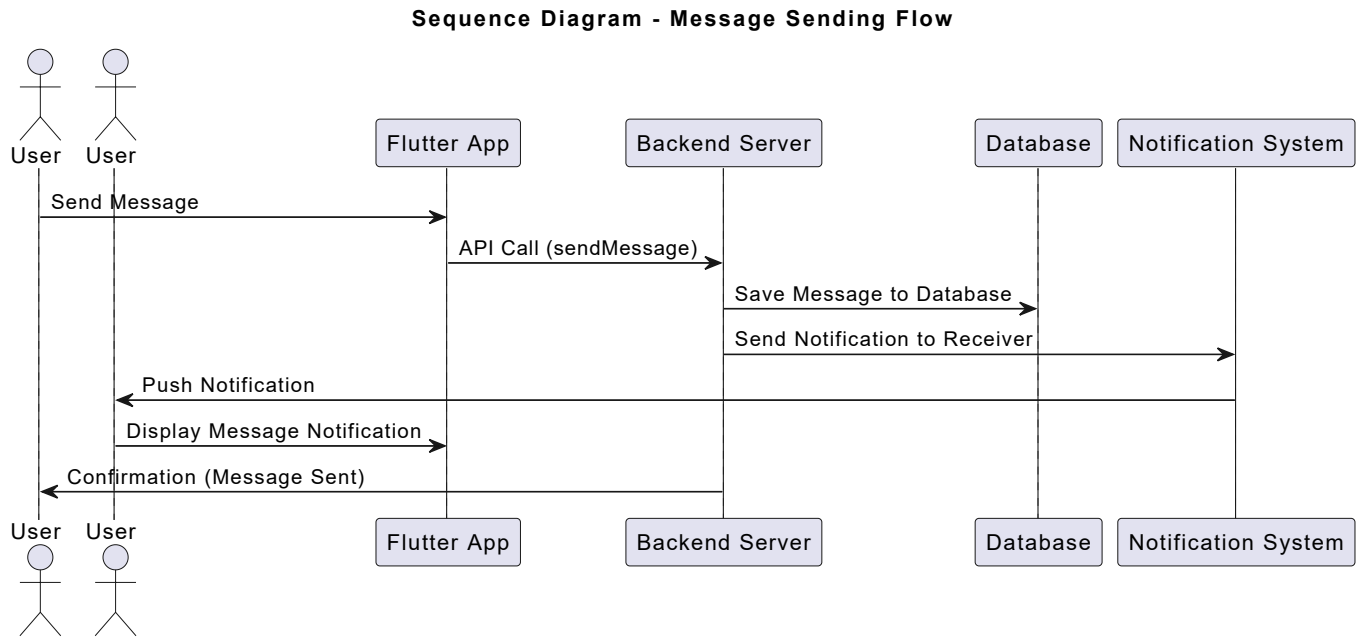
```
[
  {
    "messageId": "msg789",
    "senderId": "abc123",
    "content": "Hello!",
    "timestamp": "2024-01-01T10:00:00Z",
    "status": "read"
  }
]
```

Media Upload

- **Endpoint**: `POST /api/media/upload`
- **Description**: Uploads media files to Firebase Storage or Amazon S3.
- **Request Body**: File in multipart/form-data.
- **Response**:

```
{
  "mediaId": "media456",
  "url": "https://storage-service.com/media456.jpg"
}
```

Sequence Digram (Message Sending Flow)



Security Measures

Encryption

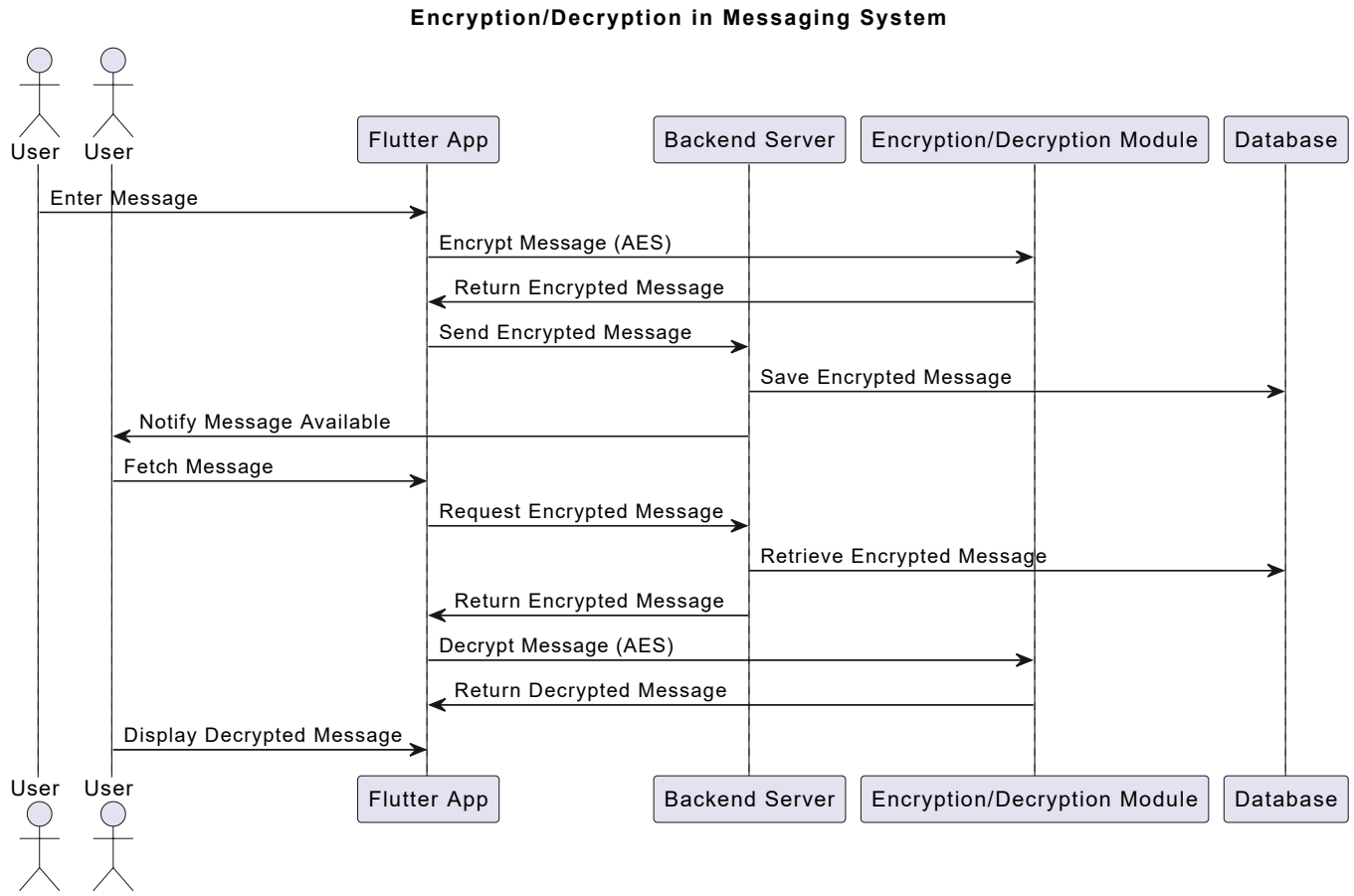
- **End-to-End Encryption**: Messages and calls are encrypted using RSA/AES for privacy.
- **Data in Transit**: Encrypted with HTTPS to protect data integrity.

Authentication

- **JWT Token**: Used for secure sessions.
- **Email Verification**: Users register using email and password, with optional email verification for added security.

Privacy and Compliance

- **GDPR Compliance**: Data retention policies and user data management meet GDPR standards.



Scaling Plan

Database Sharding

As user and message data grows, we'll implement sharding on the message and user tables to distribute load effectively.

Load Balancing

Use load balancing across multiple servers to ensure high availability and reduce latency.

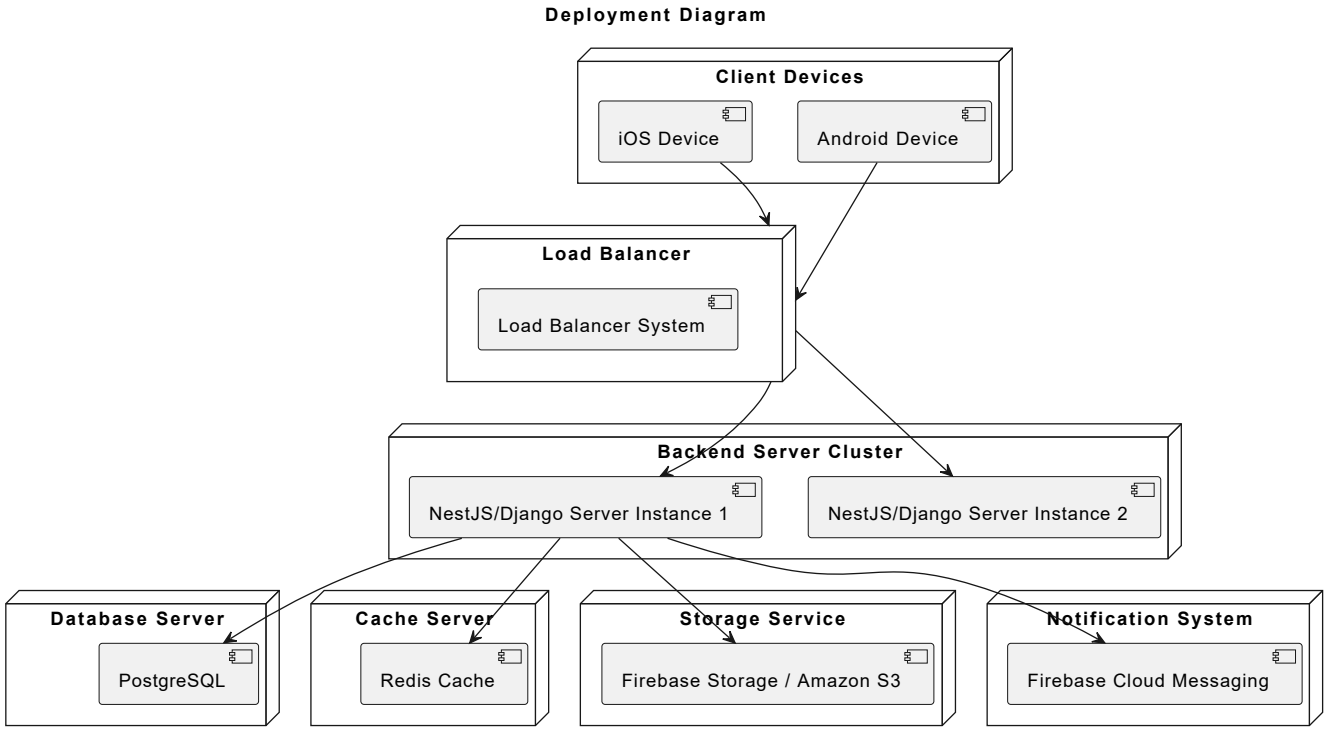
Caching

Redis caching for frequently accessed data (e.g., session management).

Backup Strategy

Automated daily backups of PostgreSQL databases and Firebase Storage to prevent data loss.

Deployment Diagram

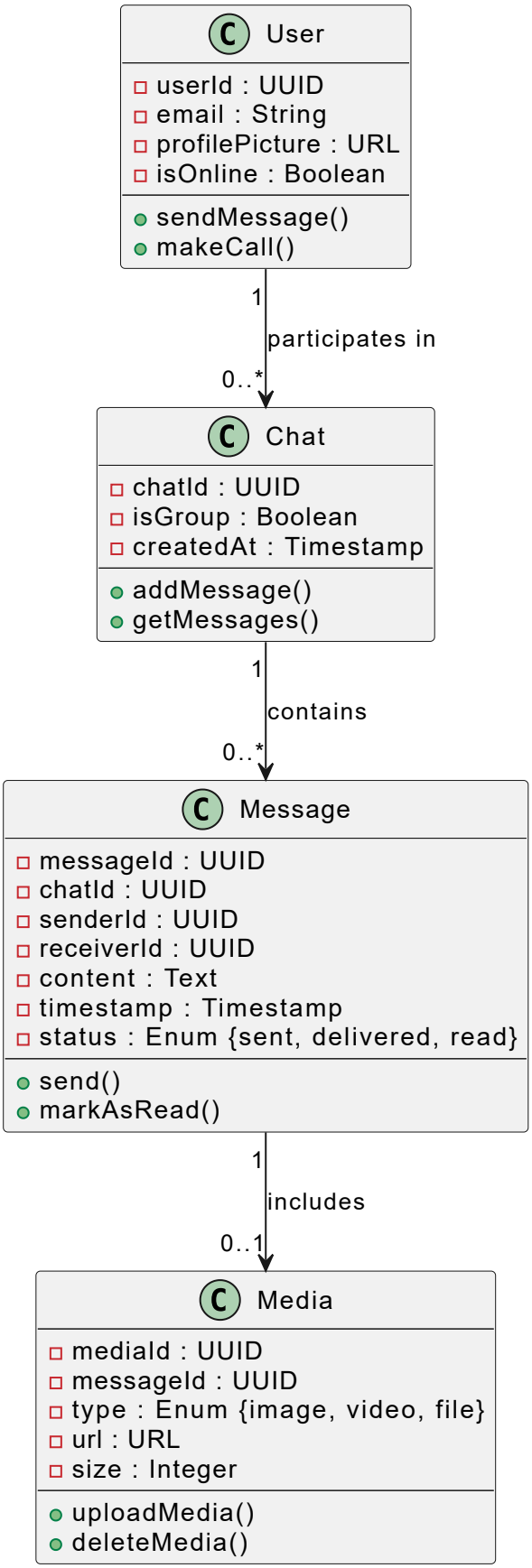


UML Class Diagram

Key Classes

1. **User**
   - **Attributes**: `userId`, `email`, `profilePicture`, `isOnline`.
   - **Methods**: `sendMessage()`, `makeCall()`.
2. **Chat**
   - **Attributes**: `chatId`, `isGroup`, `createdAt`.
   - **Methods**: `addMessage()`, `getMessages()`.
3. **Message**
   - **Attributes**: `messageId`, `chatId`, `senderId`, `receiverId`, `content`, `timestamp`, `status`.
   - **Methods**: `send()`, `markAsRead()`.
4. **Media**
   - **Attributes**: `mediaId`, `messageId`, `type`, `url`, `size`.
   - **Methods**: `uploadMedia()`, `deleteMedia()`.

UML Class Diagram



UI/UX Design Specifications

Design Guidelines

(Recomendations but you are open to select your best)

- **Primary Colors**: #0084ff (Blue), #ffffff (White), #f0f0f0 (Light Gray)
- **Font**: San Francisco or similar
- **Icons**: Material Design Icons (or custom icons as needed)

Screens

1. Welcome Screen

- **Purpose**: Display a warm welcome to users and prompt them to sign in or register.
- **Elements**:
  - **Logo**: Top center.
  - **App Tagline**: Under the logo, e.g., “Secure messaging for everyone.”
  - **Buttons**:
    - **Sign In**: Leads to the Sign-In screen.
    - **Register**: Leads to the Registration screen.

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2. Registration Screen

- **Purpose**: Allow new users to create an account using email.
- **Elements**:
  - **Email Field**: Input field with “Email Address” placeholder.
  - **Password Field**: Secure input with “Password” placeholder.
  - **Confirm Password**: Secure input with “Confirm Password” placeholder.
  - **Register Button**: CTA to create an account.
  - **Sign In Redirect**: Text link, “Already have an account?” leading to Sign-In.

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3. Sign-In Screen

- **Purpose**: For existing users to log in using email.
- **Elements**:
  - **Email Field**: Input for email.
  - **Password Field**: Secure input for password.
  - **Sign In Button**: CTA to log in.
  - **Forgot Password**: Link to Password Recovery Screen.

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4. Password Recovery Screen

- **Purpose**: Let users reset their password via email.
- **Elements**:
  - **Email Field**: Input to enter the registered email.
  - **Reset Password Button**: CTA to initiate reset process.

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5. Home Screen (Chat List)

- **Purpose**: Display the user's active chats with recent messages and unread indicators.
- **Elements**:
  - **Chat List**: Each chat has:
    - **Contact Name**: Bold text.
    - **Last Message Preview**: Gray text.
    - **Timestamp**: Right-aligned.
    - **Unread Indicator**: Small dot or badge for unread messages.
  - **Search Bar**: Top bar for searching conversations.
  - **New Chat Button**: Icon to initiate new chat.

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6. Chat Screen

- **Purpose**: Display chat messages and facilitate user interaction.
- **Elements**:
  - **Messages Area**: Bubbles for sent and received messages.
  - **Text Input Field**: Input for typing messages.
  - **Send Button**: Icon to send message.
  - **Attachment Icon**: For selecting media/files.
  - **Back Button**: Top left for navigation back to Home.

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7. Contacts Screen

- **Purpose**: Display and manage contacts for new conversations.
- **Elements**:
  - **Contacts List**: Display contacts using the app.
  - **Add Contact**: Icon or button to add a new contact manually.
  - **Search Bar**: For filtering contacts.

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8. Settings Screen

- **Purpose**: Customize app preferences, security, and account information.
- **Sections**:
  - **Account Settings**: Change email, password, and profile info.
  - **Security**: Configure two-factor authentication.
  - **Notifications**: Manage message notifications.
  - **Privacy**: Configure privacy preferences.
  - **Backup and Restore**: Options for chat backups.
  - **Delete Account**: Option to permanently delete the account.

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9. User Profile Screen

- **Purpose**: Update user information.
- **Elements**:

- **Profile Picture**: Editable by tapping.
- **Name**: Editable text field for display name.
- **Email**: Non-editable text field.

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10. Group Chat Management Screens

Group Info Screen

- **Purpose**: Show group details and manage members.
- **Elements**:
  - **Group Name**: Editable text.
  - **Member List**: Display all group members.
  - **Media**: Recent media shared in the group.
  - **Add Member**: Button for admins to add members.

Create Group Screen

- **Purpose**: Create a new group with selected contacts.
- **Elements**:
  - **Contact Selection**: Checkbox for each contact.
  - **Group Name**: Input field.
  - **Create Button**: CTA to finalize group creation.

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11. Media and Attachment Screens

Media Viewer

- **Purpose**: Full-screen view of images or videos.
- **Elements**:
  - **Zoom Controls**: Pinch-to-zoom or buttons.
  - **Download Button**: For saving media.

Attachment Screen

- **Purpose**: Allow users to select attachments.
- **Elements**:
  - **Attachment Types**: Options for photo, video, document, location.

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12. Search Screen

- **Purpose**: Search contacts, messages, and media.
- **Elements**:
  - **Search Input**: Top bar.
  - **Filter Options**: Buttons for “Contacts,” “Messages,” and “Media.”

Notes for Designers

1. **Interactive Elements**: Ensure buttons, input fields, and icons are distinguishable.
2. **Consistent Layouts**: Maintain consistent padding, margins, and font sizes across screens.
3. **Scalable Design**: Make elements responsive for mobile and tablet views.
4. **Accessibility**: Use readable font sizes, color contrasts, and test with screen readers.
