CAUSALLY ORDERED GROUP CHAT

DISTRIBUTED SYSTEMS PROJECT

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OVERVIEW

Objective: Implement a distributed group chat application.

Key Features:

- Create and delete rooms.
- Deliver messages in causal order within each room.
- Fully distributed with no centralized server.
- High availability: users can read and write messages even when temporarily disconnected.

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ASSUMPTIONS

- **Reliability:** Clients and links are reliable**.**
- **Dynamic Participation:** Clients can join and leave the network at any time.
- **Static Rooms:** Set of participants in a room is fixed at creation.

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KEY COMPONENTS

- **Connection Management:** Handles network communication.
- **Node:** Represents a user in the system, managing rooms and message queues.
- **Room Registry:** Tracks active and deleted rooms.
- **Messages:** Various message types for communication (e.g., RoomMessage, logRequestMessage).

CONNECTION MANAGEMENT

- **Multicast and Broadcast:**
  - Multicast for room-specific messages.
  - Broadcast for general announcements (e.g., heartbeat).
- **Message Handling:** Send and receive messages, serialize and deserialize messages.
- **User Discovery:** Update known users from received messages.
- **Heartbeat Mechanism:** Regularly broadcast presence and room updates.

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NODE OPERATIONS

- **Creating a Room:**
  - Generates a unique multicast IP.
  - Broadcasts room creation.
- **Joining a Room:**
  - Joins the multicast group.
  - Synchronizes message logs using vector clocks.
- **Leaving a Room:**
  - Leaves the multicast group.
  - Updates room registry.
- **Sending Messages:**
  - Ensures causal order using vector clocks.

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ENSURING CAUSAL ORDER

- **Vector Clocks:**
  - Each message carries a vector clock.
  - Ensures messages are delivered in causal order.
- **Message Queue:**
  - Holds messages until they can be delivered in the correct order.
  - Updates local clock and logs.

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HANDLING DISCONNECTIONS

- **High Availability:**
  - Users can continue to read/write messages while disconnected.
  - Messages are synchronized upon reconnection.
- **Log Requests:**
  - Request missing messages using logRequestMessage.
  - Respond to log requests with logResponseMessage.

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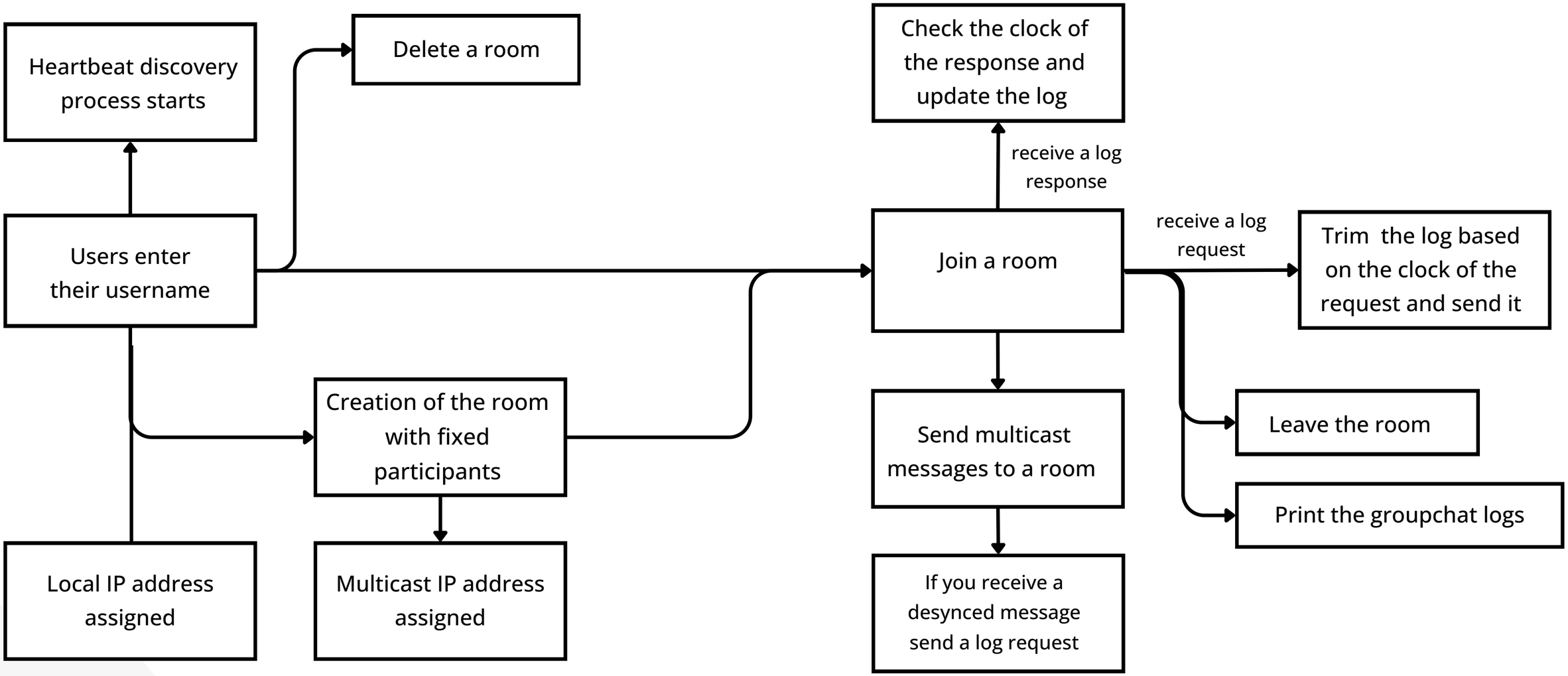
MESSAGE FLOW SYSTEM



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DEMONSTRATION

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CHALLENGES AND SOLUTIONS

- **Causal Ordering:**
  - Implementing and managing vector clocks.
- **High Availability:**
  - Ensuring message delivery during and after disconnections.
- **Distributed Environment:**
  - Synchronizing state across multiple clients.

FUTURE IMPROVEMENTS

- **Dynamic Room Participants:**
  - Allow adding/removing participants after room creation.
- **Enhanced Fault Tolerance:**
  - Better handling of network partitions.
- **User Interface:**
  - Develop a more user-friendly interface for the chat application.

THANK YOU

ANY QUESTIONS?

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