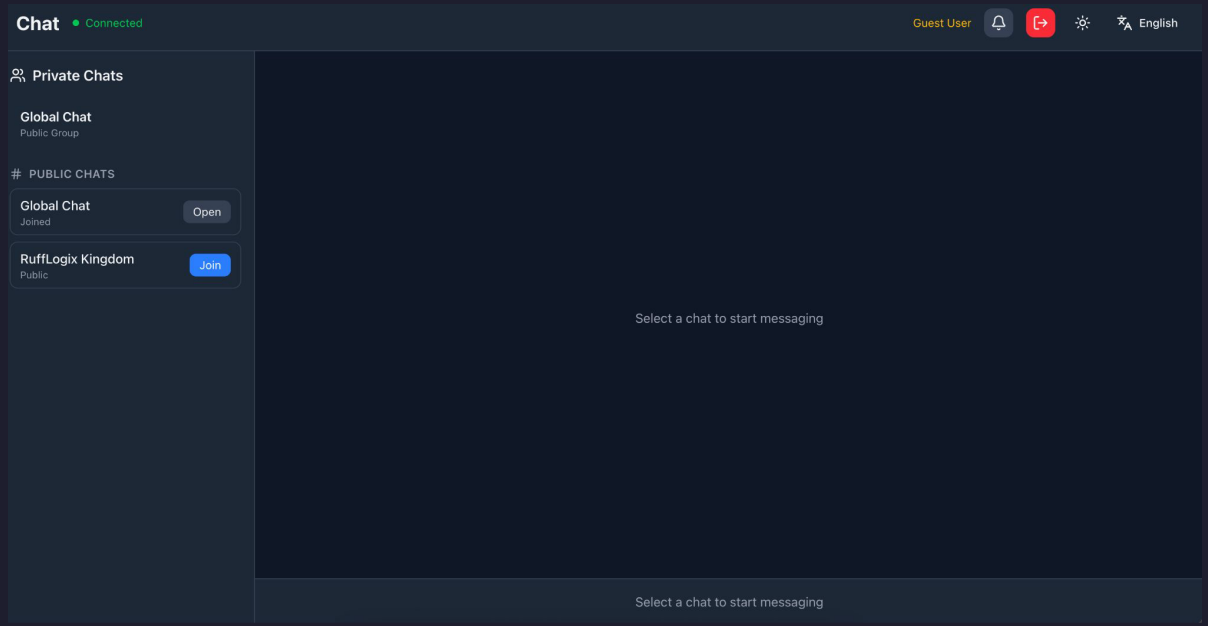
Socket Programming

Socket programming is a way to connect 2 nodes on a network to communicate to each other.
One socket listen particular port at the IP address while the other socket while the client reaches out to the server.

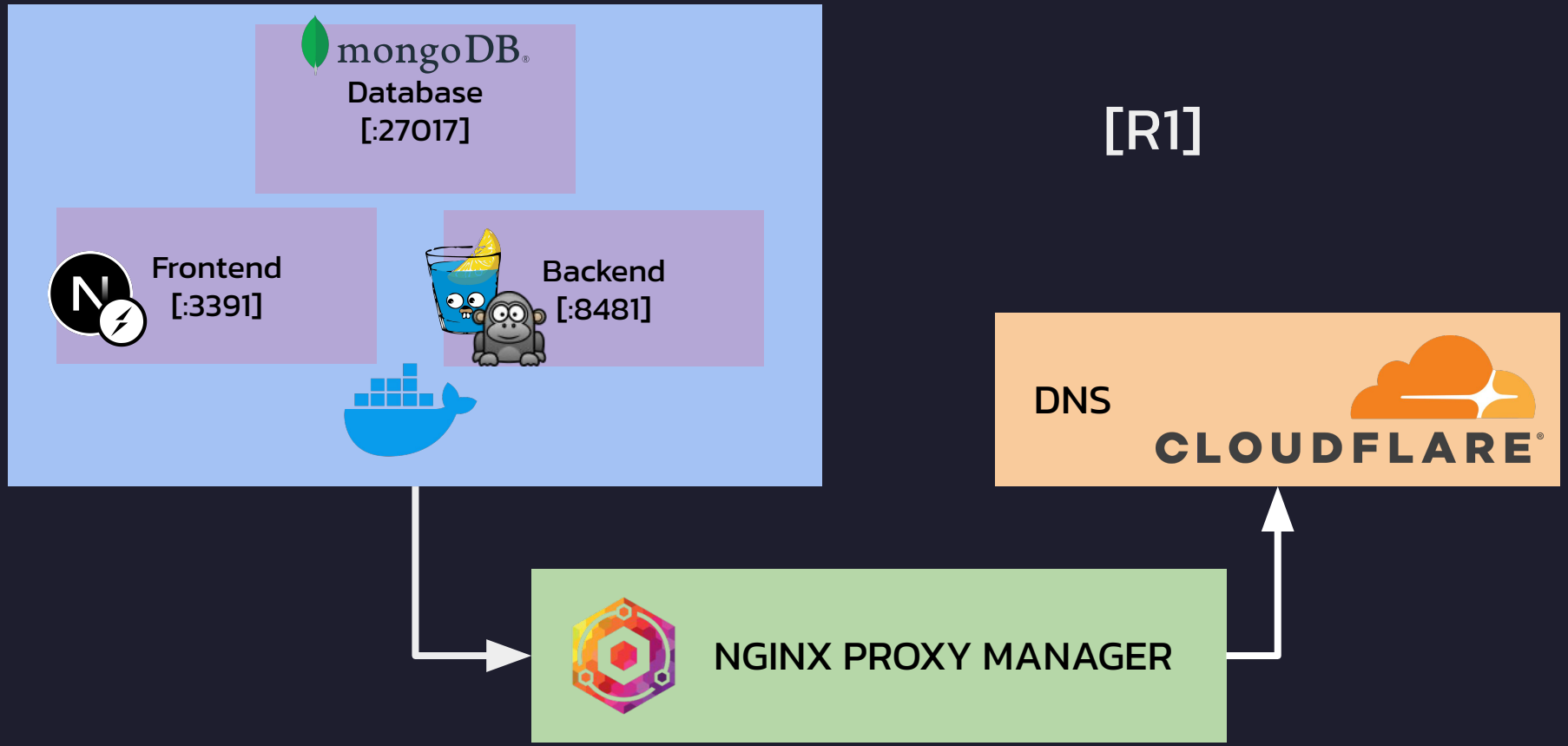
Objective

This project is chat web application using web socket for realtime communication.



[PART I]
System Architecture Design

Part I: System Architecture Design



Part I: System Architecture Design

[R2] Socket connections between frontend and backend

Socket Programming

```
const connect = () => {
      // Note: WebSocket doesn't support custom headers in browser
      // Token needs to be passed via query parameter or sent after
connection
      const token =
        typeof window !== "undefined"
          ? localStorage.getItem("auth_token")
          : null;
      const wsUrl = token
        ? `${WS_BASE_URL}/ws?token=${encodeURIComponent(token)}`
        : `${WS_BASE_URL}/ws`;

      console.log("WebSocket: Connecting to", wsUrl);
      ws.current = new WebSocket(wsUrl);
      // ...
```

Socket Programming

```
func (h *implWSHandler) HandleWS(w http.ResponseWriter, r *http.Request) {
  conn, err := upgrader.Upgrade(w, r, nil)
  if err != nil {
    log.Printf("Failed to upgrade connection: %v", err)
    http.Error(w, "Could not open websocket connection",
http.StatusBadRequest)
    return
  }
  defer conn.Close()

  var userID int64
  log.Printf("WebSocket connection established from %s", r.RemoteAddr)

  // Set read deadline to prevent hanging connections
  conn.SetReadDeadline(time.Time{})
  // ...
```

[PART II]
Fundamental Implementation

Implementation Details

Server Side:

Connection Handling

- REST: HTTP Routes (/login, /register, etc.)
- SOCKET: websocket support (/ws route)

Room Management

- Map (userId, chatId, rooms)

Event Handling

- When client connects to socket, server will wait for messages
- The transferred data will be in JSON

Implementation Details

Client Side:

Connection

- Use custom React hook
- When user tried to connect, will create new WebSocket client

Message Event

- Will call sendMessage function in React hook to send data via websocket
- The React hook will create JSON payload and send to the server socket

Receiving Event

- The React hook will listen to the event from the server
- When event occur, there is function to handle the event, render web page again

Implementation Details

User Management
- Username must be unique
- Client List
  - There is a list of online users

Chat Room
- Chat Rooms
  - Every chat room are isolated
  - Chat intergace

Implementation Details

[R3] Each client must have unique name

Socket Programming

```go
func (s *implAuthService) Register(username, password, name, email string)
(*entity.User, string, error) {
  // Check if user already exists
  existingUser, _ := s.userRepo.GetUserByUsername(username)
  if existingUser != nil {
    return nil, "", errors.New("username already exists")
  }
  // ...
```

Implementation Details

[R4] Each client can see a list of names of all clients that are currently connected to the server including its own name

Socket Programming

```
func (h *implWSHandler) broadcastOnlineUsersList() {
  onlineUserIDs := h.roomService.GetOnlineUsers()

  // Send personalized online user lists to each
  for _, userID := range onlineUserIDs {
    h.sendOnlineUsersList(userID)
  }
}
```

Socket Programming

```
func (s *implRoomService) GetOnlineUsers() []int64 {
  s.mutex.RLock()
  defer s.mutex.RUnlock()

  userIDs := make([]int64, 0, len(s.clients))
  for userID := range s.clients {
    userIDs = append(userIDs, userID)
  }
  return userIDs
}
```

Implementation Details

[R5] Each chat between clients (both Private and Group message) must have its own chat room.

Socket Programming

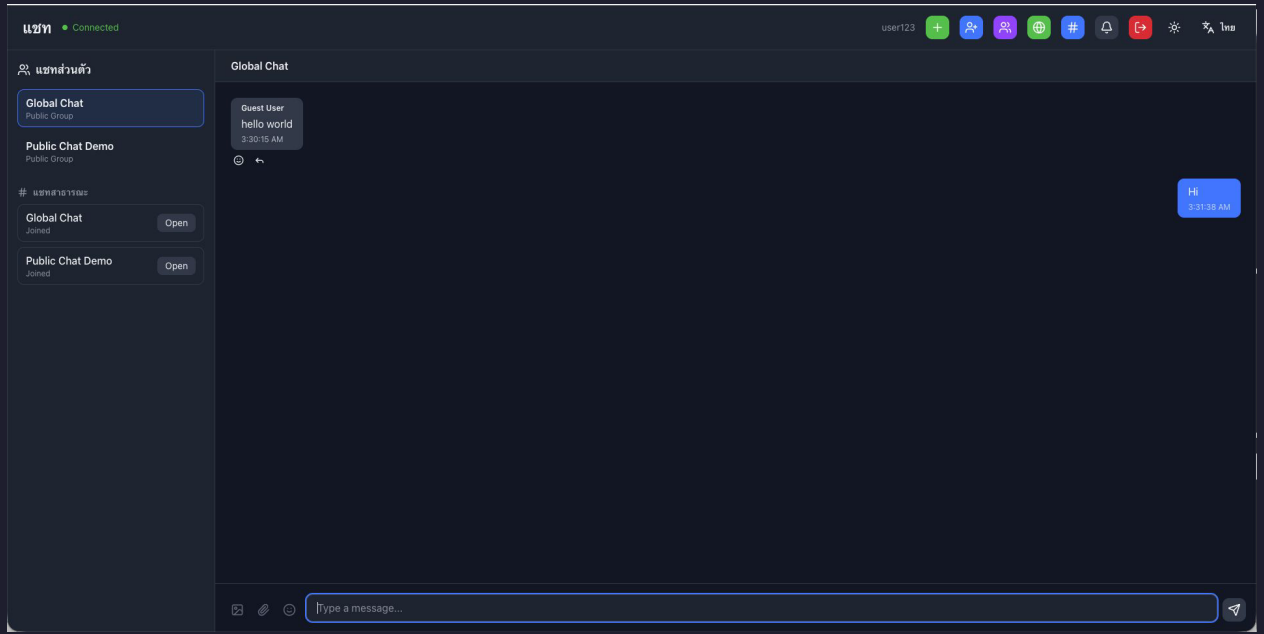
```tsx
const joinChat = useCallback(
    (chatId: number) => {
      console.log(`Joining chat ${chatId} for user ${userId}`);
      sendEvent({
        type: EVENT_TYPES.JOIN,
        data: {
          chat_id: chatId,
        },
        created_by: userId,
      });
    },
    [sendEvent, userId]
  );
```

Socket Programming

```go
func (h *implHTTPHandler) sendMessage(c *gin.Context) {
  chatID, _ := strconv.ParseInt(c.Param("id"), 10, 64)

  var req struct {
    Content   string `json:"content"`
    Type      string `json:"type" binding:"required"`
    MediaURL  string `json:"media_url"`
    FileName  string `json:"file_name"`
    FileSize  int64  `json:"file_size"`
    ReplyToID *int64 `json:"reply_to_id"`
  }

  if err := c.ShouldBindJSON(&req); err != nil {
    c.JSON(http.StatusBadRequest, gin.H{"error": err.Error()})
    return
  }
  // ...
```

Implementation Details

[R6] Each chat room (both Private and Group message) must include a chat box for sending text messages and chat window for displaying the sent messages and new incoming messages.



Implementation Details

[R7] Each client can send a direct text message to any clients in the list. Only the sender and receiver can see the messages.

Socket Programming

```go
func (r *implChatRepository) CreateMessage(message *entity.Message) error {
  r.mu.Lock()
  defer r.mu.Unlock()

  r.messageID++
  message.ID = r.messageID
  message.CreatedAt = time.Now()
  message.UpdatedAt = time.Now()
  if message.Reactions == nil {
    message.Reactions = []*entity.Reaction{}
  }

  if message.ReplyToID != nil {
    if reply, ok := r.messages[*message.ReplyToID]; ok {
      message.ReplyTo = reply
    }
  }

  r.messages[message.ID] = message
  return nil
}
```

Implementation Details

Socket Programming

```go
func (h *implHTTPHandler) createChat(c *gin.Context) {
  var req struct {
    Name        string `json:"name" binding:"required"`
    Description string `json:"description"`
    IsPublic    bool   `json:"is_public"`
    Type        string `json:"type" binding:"required"`
  }

  if err := c.ShouldBindJSON(&req); err != nil {
    c.JSON(http.StatusBadRequest, gin.H{"error": err.Error()})
    return
  }

  // Get user ID from context (assumes auth middleware sets this)
  userID := c.GetInt64("user_id")

  chat := &entity.Chat{
    Type:        entity.ChatType(req.Type),
    Name:        req.Name,
    Description: req.Description,
    IsPublic:    req.IsPublic,
    CreatedBy:   userID,
  }

  if err := h.chatService.CreateChat(chat); err != nil {
    c.JSON(http.StatusInternalServerError, gin.H{"error": err.Error()})
    return
  }

  // Add creator as admin member
  h.chatService.AddMember(chat.ID, userID, "admin")

  c.JSON(http.StatusCreated, chat)
}
```

[R8] Each client can create a chat group(s), which initially includes only themselves as a member.

Implementation Details

[R9] Each client can see a list of all existing chat groups (with the member list) created by any clients.

>> More in Next Slide <<

Socket Programming

```go
func (h *implHTTPHandler) getAllChats(c *gin.Context) {
  userID, exists := c.Get("user_id")
  if !exists {
    c.JSON(http.StatusUnauthorized, gin.H{"error": "User not authenticated"})
    return
  }

  userIDInt := userID.(int64)

  // Get all chats from the service
  allChats, err := h.chatService.GetAllChats()
  if err != nil {
    c.JSON(http.StatusInternalServerError, gin.H{"error": err.Error()})
    return
  }

  // Get online users for member status
  onlineUserIDs := h.roomService.GetOnlineUsers()
  onlineUsersMap := make(map[int64]bool)
  for _, id := range onlineUserIDs {
    onlineUsersMap[id] = true
  }

  // Define response types
  // ...

  var response []ChatWithMembersResponse
  for _, chat := range allChats {
    // Filter chats: show public chats or private chats where user is a member
    // ...
  }

  c.JSON(http.StatusOK, response)
}
```

Implementation Details

[R9] Each client can see a list of all existing chat groups (with the member list) created by any clients.

Socket Programming

```go
members, err := h.chatService.GetMembers(chat.ID)
if err != nil {
  continue // Skip chats with member fetch errors
}

var membersWithStatus []ChatMemberWithStatus
for _, member := range members {
  user, err := h.userRepository.GetUserByNumericID(member.UserID)
  if err != nil {
    user = nil // Skip user details if we can't fetch
  }
  membersWithStatus = append(membersWithStatus, ChatMemberWithStatus{
    ChatMember: *member,
    User:       user,
    IsOnline:   onlineUsersMap[member.UserID],
  })
}

response = append(response, ChatWithMembersResponse{
  Chat:    *chat,
  Members: membersWithStatus,
})
```

Socket Programming

```go
if !chat.IsPublic {
  // Check if user is a member of this private chat
  isMember := false
  members, err := h.chatService.GetMembers(chat.ID)
  if err != nil {
    continue // Skip chats with member fetch errors
  }
  for _, member := range members {
    if member.UserID == userIDInt {
      isMember = true
      break
    }
  }
  if !isMember {
    continue // Skip private chats where user is not a member
  }
}
```

Implementation Details

[R10] Clients can choose to join a group chat only by themselves; they are not added automatically by the group creator.

Socket Programming

```go
func (s *implRoomService) JoinRoom(userID, chatID int64) bool {
  s.mutex.Lock()
  defer s.mutex.Unlock()

  // Check if user is already in the room
  if s.rooms[chatID] != nil && s.rooms[chatID][userID] {
    return false // User already in room, don't broadcast
  }

  if s.rooms[chatID] == nil {
    s.rooms[chatID] = make(map[int64]bool)
  }
  s.rooms[chatID][userID] = true

  if s.userRooms[userID] == nil {
    s.userRooms[userID] = make(map[int64]bool)
  }
  s.userRooms[userID][chatID] = true

  return true // User newly joined, should broadcast
}
```

Socket Programming

```go
func (s *implInvitationService) JoinChatViaInvitation(code string, userID int64) error {
  invitation, err := s.invitationRepo.GetChatInvitationByCode(code)
  if err != nil {
    return err
  }

  members, err := s.chatRepo.GetChatMembers(invitation.ChatID)
  if err != nil {
    return err
  }

  // Add user to chat
  member := &entity.ChatMember{
    ChatID: invitation.ChatID,
    UserID: userID,
    Role:   "member",
  }

  if err := s.chatRepo.AddChatMember(member); err != nil {
    return err
  }

  // Increment usage count
  // ...

  // Notify existing members (excluding the new member)
  // ...

  return nil
}
```

Implementation Details

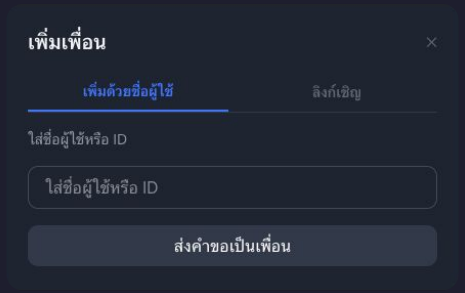
[R11] Each client can send a text message to the group that they joined. Only the members of the chat group can see the messages.

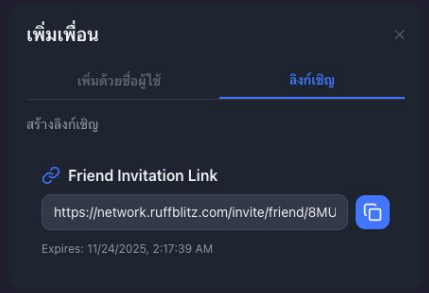
Socket Programming

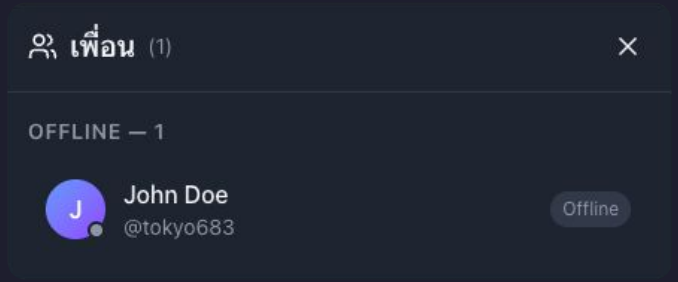
```go
func (r *MongoChatRepository) IsChatMember(chatID, userID int64) (bool, error) {
  ctx, cancel := context.WithTimeout(context.Background(), 5*time.Second)
  defer cancel()

  count, err := r.chatMembersCol.CountDocuments(ctx, bson.M{
    "chat_id": chatID,
    "user_id": userID,
  })
  if err != nil {
    return false, err
  }

  return count > 0, nil
}
```

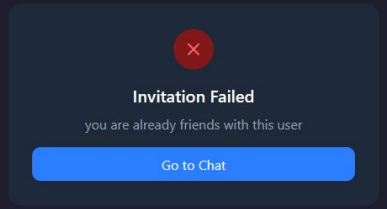
[PART III]
Special Point

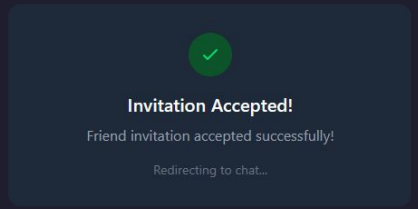
Special Point 1: Friend System

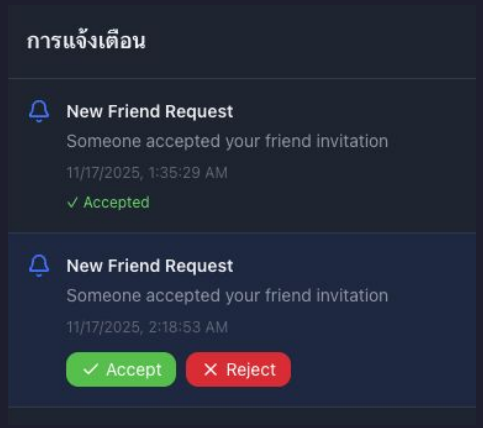




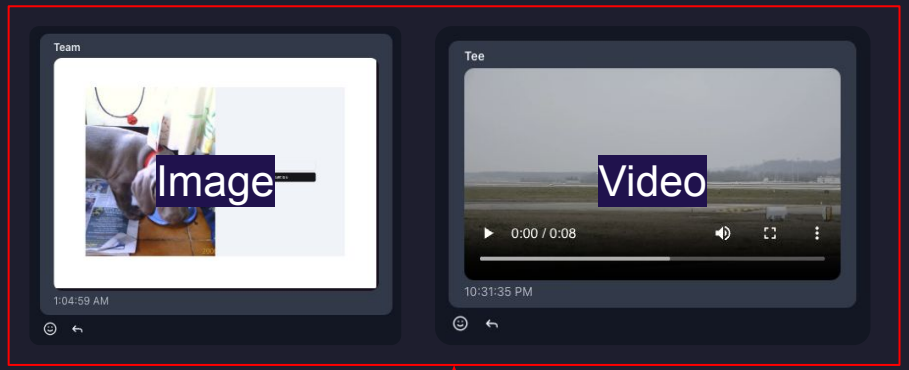


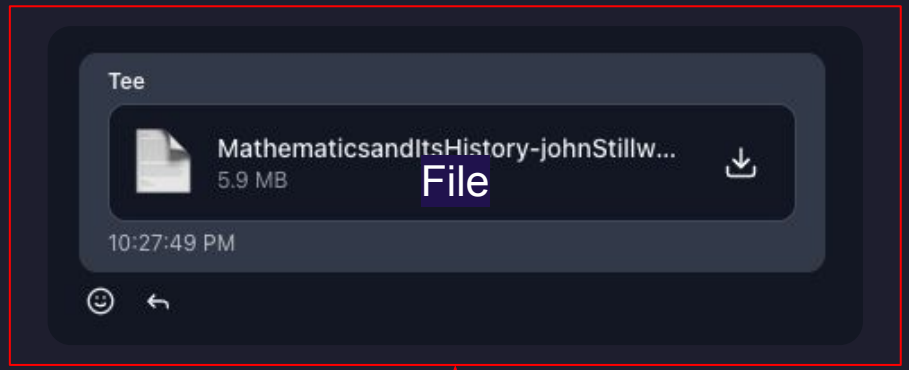






Special Point 2: Sending Photo, File, Video

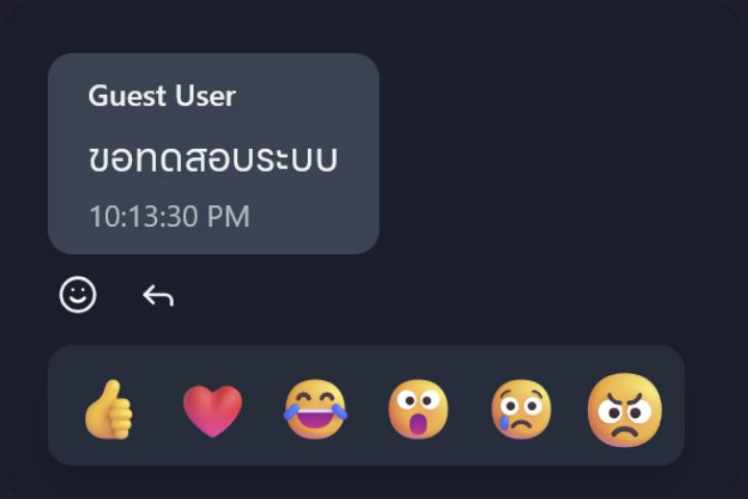




Type a message...

Special Point 3: Reply Message

Special Point 4: React Message with Emojis



Special Point 5: Translate UI

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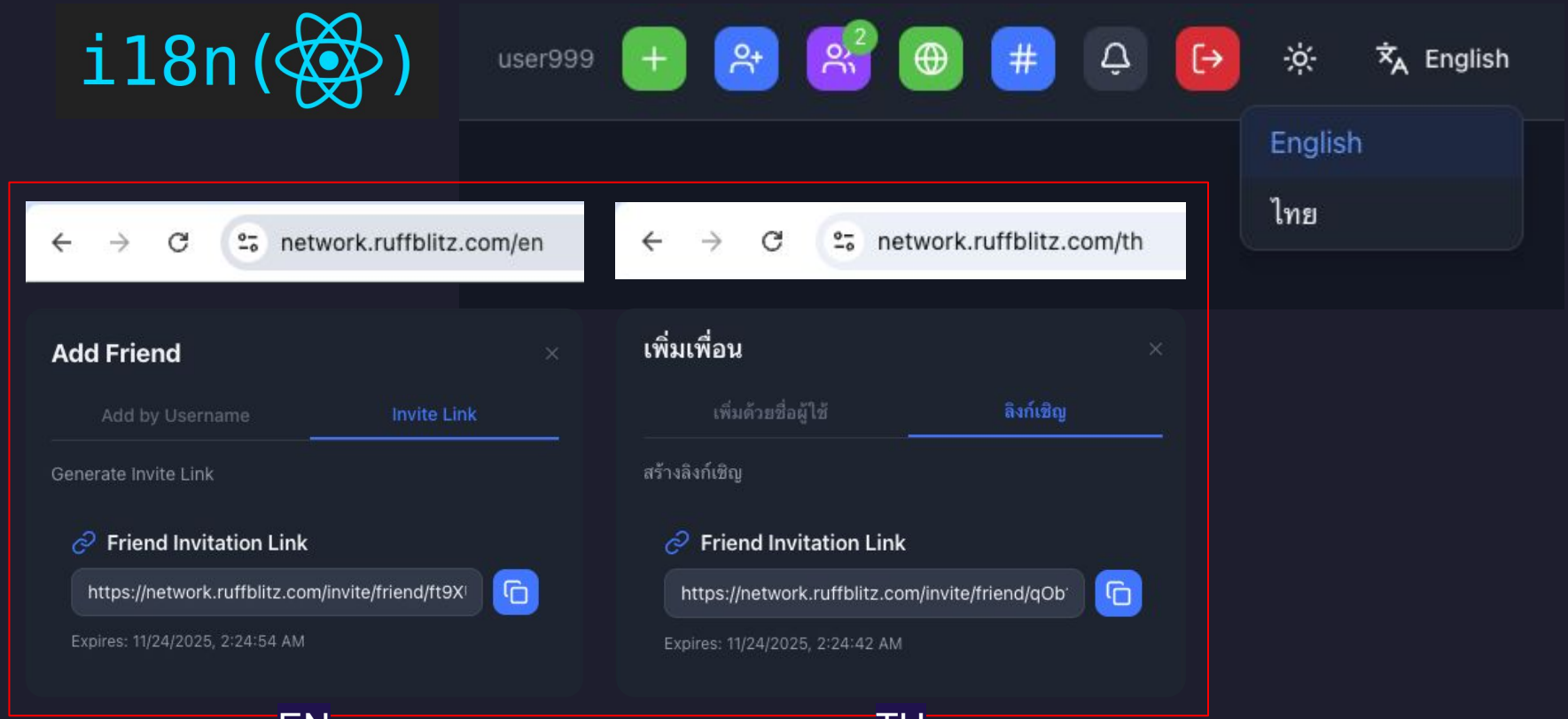
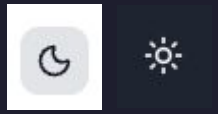
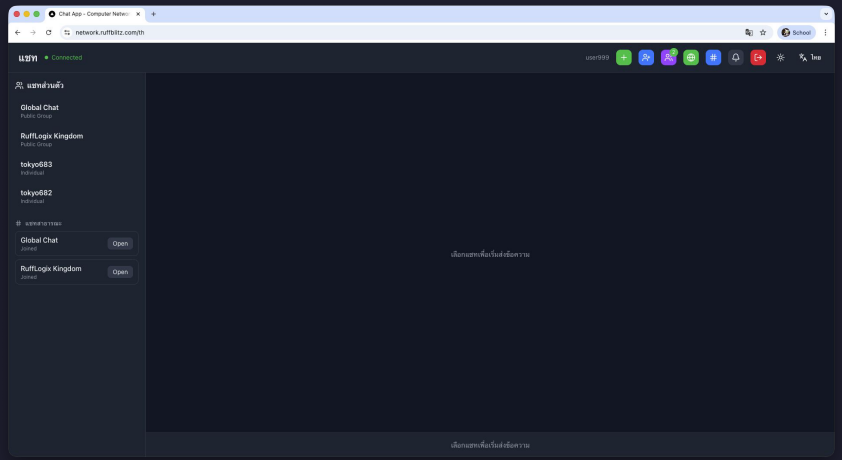
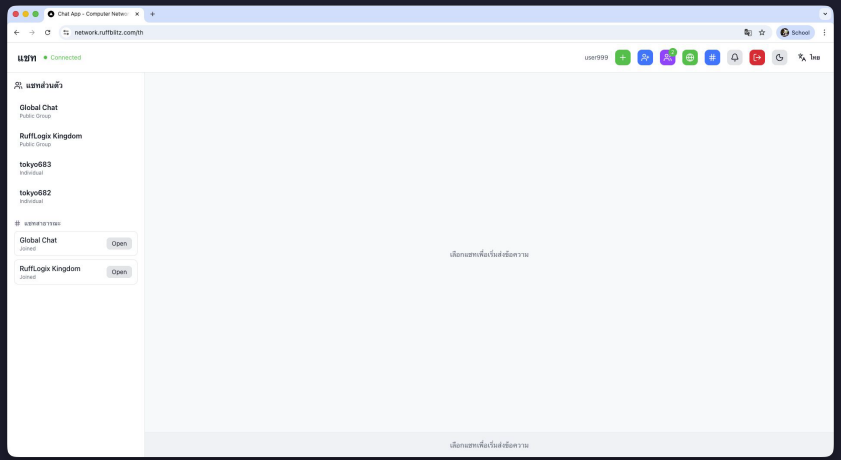


Special Point 6: Light/Dark Theme





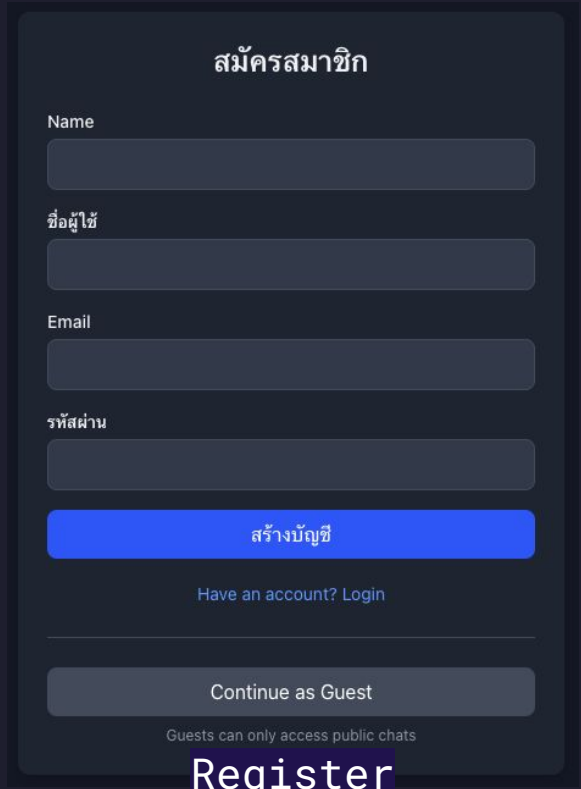
Dark Theme



Light Theme

Special Point 7: Authentication

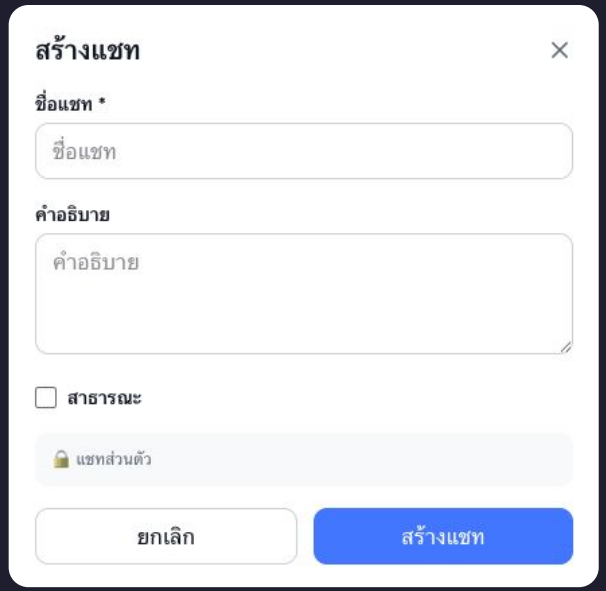
Login



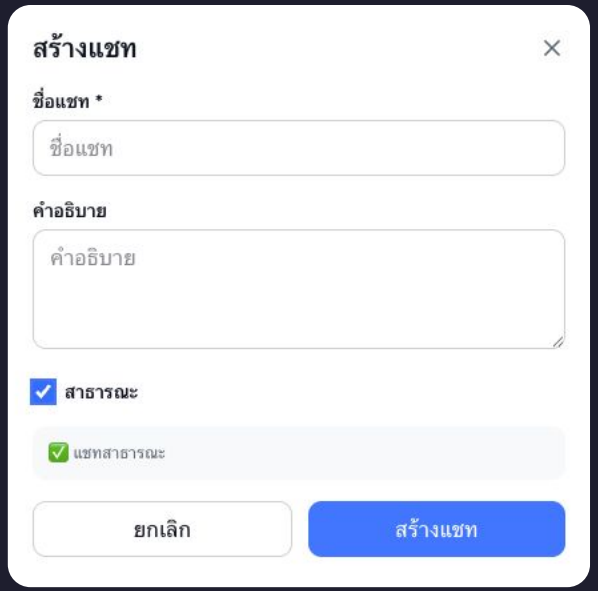
Register

1. Registered User
2. Guest User

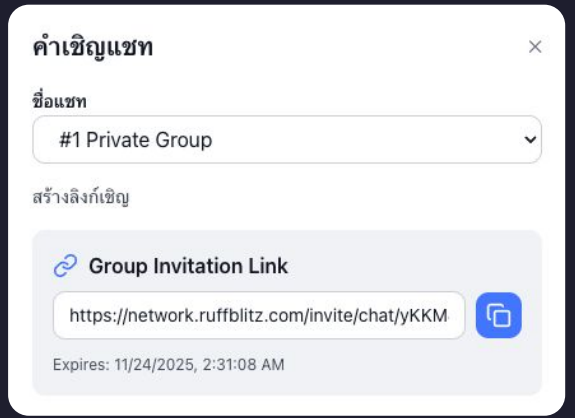
Special Point 8: Public/Private Group Chat



Create Private Chat

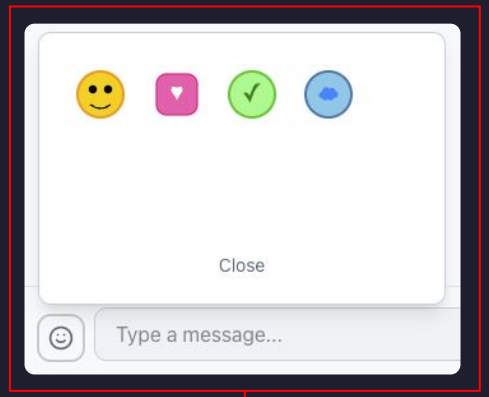


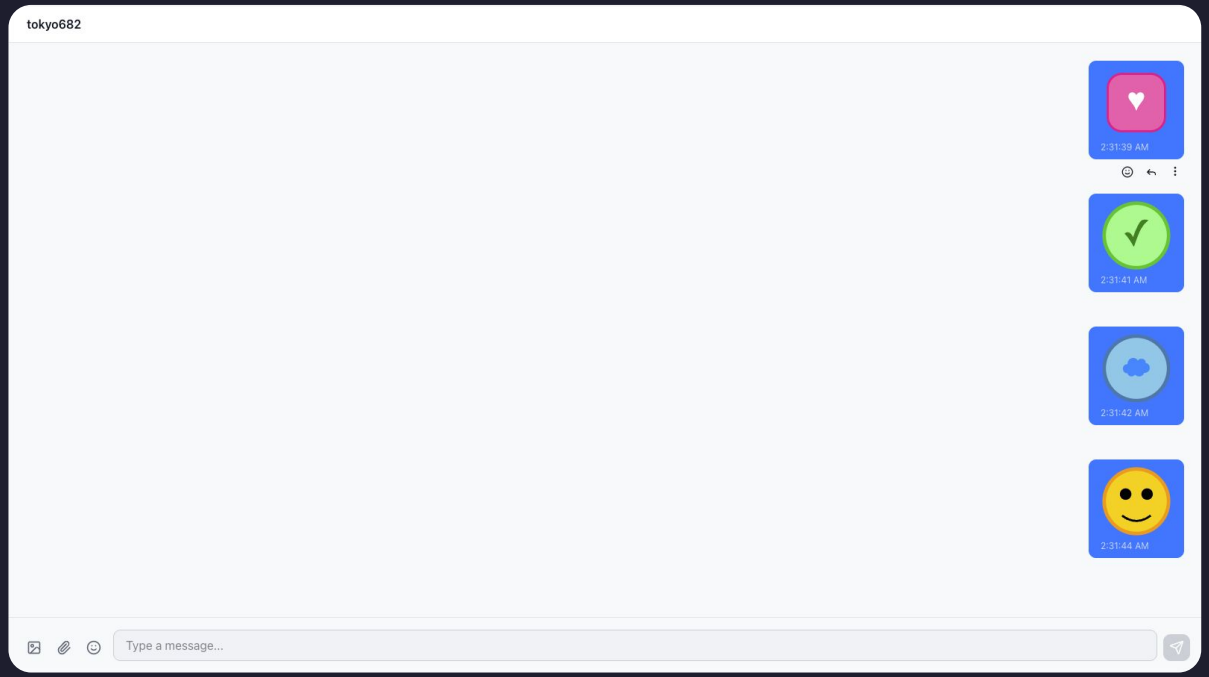
Create Public Chat



Create Invitation

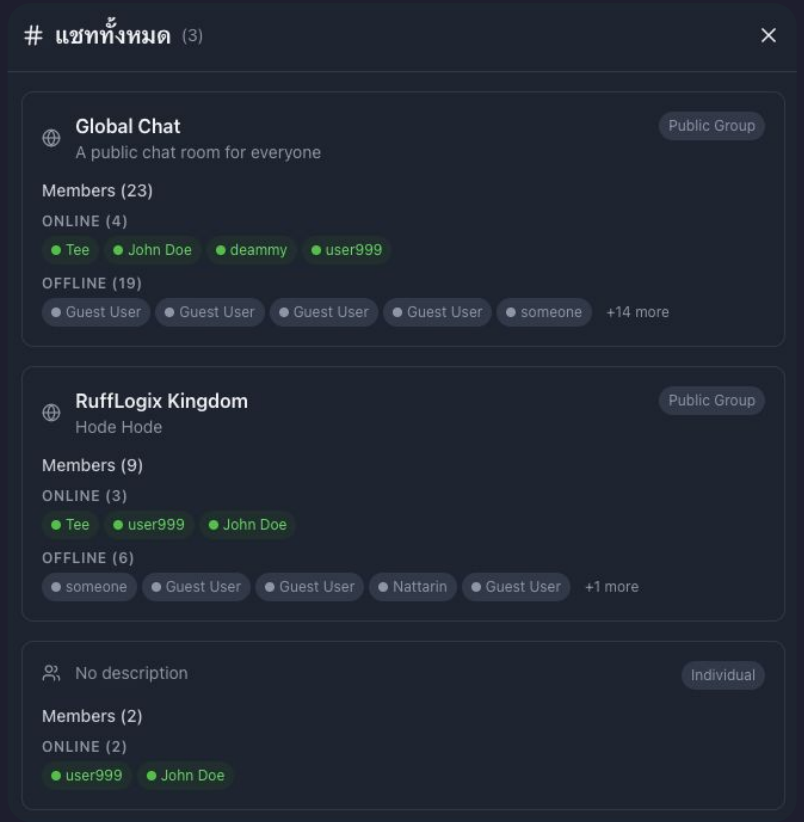
Special Point 9: Stickers





Type a message...

Special Point 10: Show Users in Chat



Show a list of chats that includes chat members for only

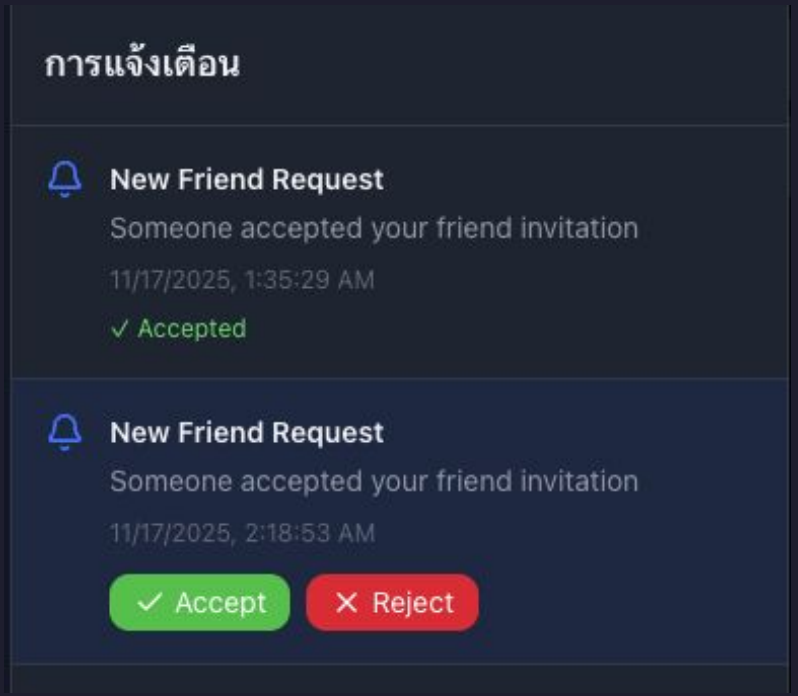
1. public chats
2. chats where the user is a member

Special Point 11: Show Current Online Users

Show all users that are currently online

Special Point 12: Notification

Show a notification when the user receives an invitation to join or add a friend



Source Code

https://github.com/RuffLogix/computer-network-project

Live Demo

https://network.ruffblitz.com

Thanks for Your Attention