

# Peer-Review 2: Communication Protocol

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## 1 Introduction

This document describes the network interactions between the server and the clients using TCP-IP socket connection and RMI API. The server allows the client to select the preferred communication protocol regardless of the choices of other clients. Efforts were made to ensure the sameness of the protocols; in fact, they share all of the data structures and most of the logic. The TCP-IP communication makes use of the default Java serialization procedure to send and receive objects over the socket.

## 2 Connecting to the Server

### 2.1 TCP-IP

The server exposes a TCP-IP socket using the Java standard net API. The default port is *1234*. After accepting the request the server will respond with an *Integer* object containing the ID number assigned to the client.

### 2.2 RMI

The server exposes a *server* object, whose interface is provided in the APPENDIX A section of this document. Similarly, it's expected by the client to expose a *client* object with the interface also described in APPENDIX A. A client is registered to the server by calling the `void register(Client client)` method on the server object. The server already provides an RMI Registry on port *1099*.

## 3 Notifying Messages

As mentioned before, both TCP-IP and RMI protocols share all the data structures used to convey the MVC messages over the network. Their interfaces are defined in the APPENDIX B-C section of this document.

### 3.1 TCP-IP

In TCP-IP communication, the Server mimics the internal functioning of the RMI protocol operating on a *ClientSkeleton* object that implements the *Client* interface. The server implements a remote procedure call (RPC) interface. For each procedure, it expects to be provided with a correct payload that implements the *ViewMessage<>* interface. For each method and request the correct payload types are listed in APPENDIX C. The server expects to receive objects only with the type described. Failing to do so will result in an error response. A correct *JoinLobby*, *CreateLobby*, *RecoverLobby* and *RequestLobby* are guaranteed to generate a *ServerResponseMessage* with "0" status. The server replies to a correct request with at least one or more objects that inherit from *ModelMessage<>* that represent a change in the game model. Every procedure could respond with a "ServerResponseMessage" with -2 as status if the server cannot satisfy the client's request for any reason. An ill-formed request will yield no change to the internal state of the server and an error *SeverResponseMessage* response. A *ServerResponseMessage* also contains the name of the request that generated it in the "Action" field. All communications occur asynchronously and no assurance could be made on the order of the message's arrival. The server can also send unsolicited *ModelMessage<>* messages whenever there is a change in the server's internal state not prompted by the client. The correct method dispatch inside the server is done by exploiting the *reflection* capability of the Java language operating on the dynamic type of the *ViewMessage<>*. The following diagrams describe the communication sequence between a client and the server; the first with a generic, internally undefined client, and the second with the actual client implemented in the project.

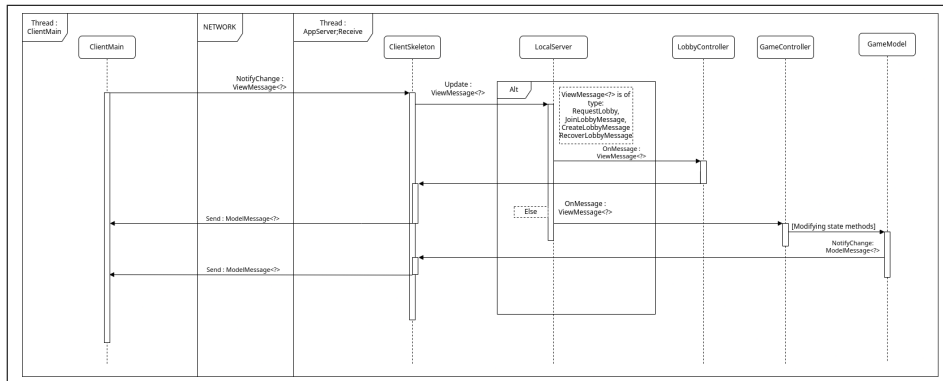


Figure 1: Client Agnostic Sequence Diagram

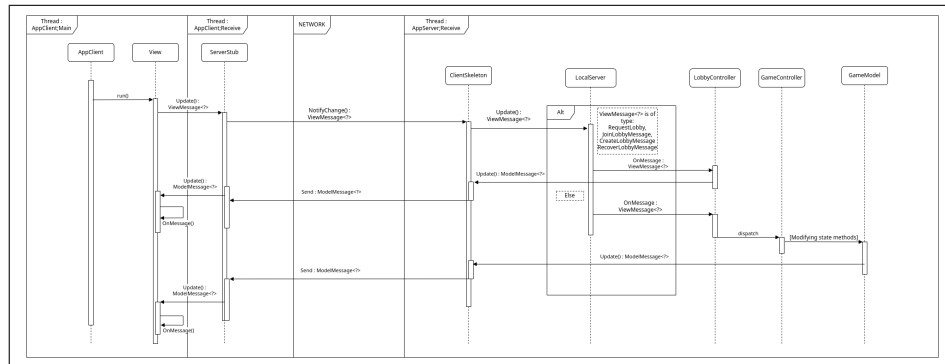


Figure 2: Implemented Client Sequence Diagram

### 3.2 RMI

The following sequence diagram describes the order of function calls that happen in the RMI protocol. As mentioned before, the server exposes a remote *server* object of *Server* type and the client needs to provide a *Client* object named "client" to the RMI registry. The RMI protocol implements the same requests as the TCP-IP protocol with the same consideration on return messages and their order.

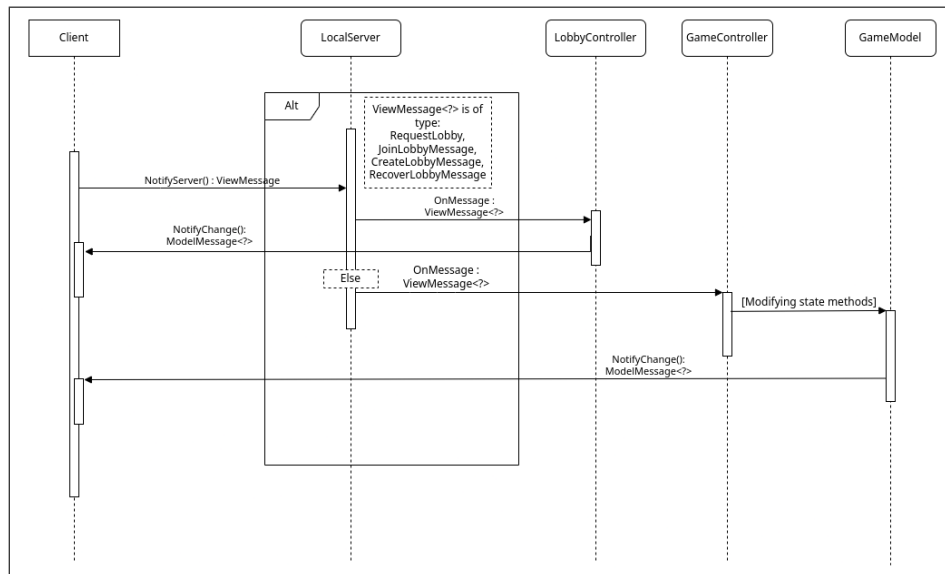


Figure 3: RMI Sequence Diagram

## 4 APPENDIX A

- Server interface.

---

```
//Server.java
public interface Server extends Remote {
    /**
     * Register a client to the server
     * @param client the client to register
     */
    void register(Client client) throws RemoteException;
    /**
     * Notify the server that a client has made a choice
     * @param message the message sent by the view
     */
    Response update(ViewMessage<?> message) throws RemoteException;
}
```

---

- Client interface.

---

```
//Client.java
public interface Client extends Remote {
    /**
     * Sets the internal client ID. Should only be called once
     * inside a Server thread.
     * The ID is unique and is used by the server to identify each
     * client.
     * @param clientID The ID number assigned by the server
     */
    void setClientID(int clientID) throws RemoteException;
    /**
     * Returns the ID client
     */
    int getClientID() throws RemoteException;
    /**
     * Notify the client of a model change
     * @param msg The object that contains the model changes
     * information
     */
    void update(ModelMessage<?> msg) throws RemoteException;
}
```

---

## 5 APPENDIX B

- Abstract ModelMessage data structure

---

```
//ModelMessage.java
abstract public class ModelMessage<Payload extends Serializable>
    implements Serializable {
    final private Payload payload;
    public Payload getPayload(){
        return payload;
    }
    public ModelMessage(Payload p){
        this.payload = p;
    }
}
```

---

- AvailableLobbyMessage implementation.

---

```
//AvailableLobbyMessage.java
public class AvailableLobbyMessage extends
    ModelMessage<LobbyPayload>{
    public AvailableLobbyMessage(List<LobbyController.LobbyView> p)
    {
        super(new LobbyPayload(p));
    }
}

//LobbyController.java->LobbyView
public record LobbyView(List<String> nicknames, int lobbySize, int
    lobbyID) implements Serializable {
    @Override
    public String toString() {
        StringBuilder nickames = new StringBuilder();
        for( String nickname : this.nicknames() ) {
            nickames.append("\t").append(nickname).append("\n");
        }
        return ("\n-----LOBBY: " + this.lobbyID() + "-----\n") +
            ("Occupancy: [" + this.nicknames().size() + "/" +
                this.lobbySize() + "]\n")
            + nickames;
    }
}
```

---

- BoardMessage implementation, signals a change in the game board.

---

```
//BoardMessage.java
public class BoardMessage extends ModelMessage<Board> {
    public BoardMessage(GameModel p) {
        super(p.getBoard());
    }
}
```

```
    }  
}
```

---

- CommonGoalMessage implementation, notifies the update of the current common goal top score.

---

```
//CommonGoalMessage.java  
public class CommonGoalMessage extends  
    ModelMessage<CommonGoalPayload>{  
    public CommonGoalMessage(Integer CommonGoalId,  
        CommonGoalPayload.Type type, Integer topScoreAvailable) {  
        super(new CommonGoalPayload(CommonGoalId, type,  
            topScoreAvailable));  
    }  
}  
//CommonGoalPayload.java  
public record CommonGoalPayload(Type type, int availableTopScore)  
    implements Serializable {  
    public enum Type{  
        X, Y  
    }  
}
```

---

- CurrentPlayerMessage implementation, notify the change of the current player whose nickname is the payload.

---

```
//CurrentPlayerMessage.java  
public class CurrentPlayerMessage extends ModelMessage<String>{  
    public CurrentPlayerMessage(String p) {  
        super(p);  
    }  
}
```

---

- EndGameMessage implementation, signals the end of the game and contains the winning player and a leaderboard with all the players' points.

---

```
//EndGameMessage.java  
public class EndGameMessage extends ModelMessage<EndGamePayload>{  
    public EndGameMessage(EndGamePayload p) {  
        super(p);  
    }  
}  
//EndGamePayload.java  
public record EndGamePayload(String winner, Map<String, Integer>  
    points) implements Serializable {}
```

---

- IncomingChatMessage implementation, notifies the arrival of a new chat message. Contains the nickname of the sender.

---

```
//IncomingChat.java
public class IncomingChatMessage extends ModelMessage<String>{
    private final String sender;
    public IncomingChatMessage(String p, String sender) {
        super(p);
        this.sender = sender;
    }
    public String getSender() {
        return sender;
    }
}
```

---

- ServerResponseMessage implementation, notifies the correct result of the CreateLobby, JoinLobby, RequestLobby, RecoverLobby requests or a server/network error. An error caused by the client has a negative status, an error caused by the server has a positive status, a correct response has status = 0.

---

```
//ServerResponseMessage.java
public class ServerResponseMessage extends ModelMessage<Response> {
    public ServerResponseMessage(Response response) {
        super(response);
    }
}

//Response
public record Response(int status, String msg, String Action)
    implements Serializable {
    public boolean isOk() { return status == 0; }
    @Override
    public String toString(){
        return status + ", " + msg;
    }
}
```

---

- ShelfMessage implementation, signals the change of a player's shelf. Contains the player's nickname.

---

```
//ShelfMessage.java
public class ShelfMessage extends ModelMessage<Shelf> {
    private final String player;
    public ShelfMessage(Shelf p, String player) {
        super(p);
        this.player = player;
    }
    public String getPlayer(){
        return this.player;
    }
}
```

```
    }  
}
```

---

- StartGameMessage implementation, signals the start of the game and contains the list of nicknames of all players, the common goals IDs and for each player its personal goal ID.

---

```
//StartGameMessage.java  
public class StartGameMessage extends  
    ModelMessage<StartGamePayload> {  
    public StartGameMessage(List<String> p, Integer personalGoalId,  
        Integer XCGnumber, Integer YCGnumber) {  
        super(new StartGamePayload(p, personalGoalId, XCGnumber,  
            YCGnumber));  
    }  
}  
//StartGamePayload.java  
public record StartGamePayload(List<String> nicknames, int  
    personalGoalId, int XCGnumber, int YCGnumber) implements  
    Serializable {}
```

---

- UpdateScoreMessage implementation, notifies that the player *player* has attained new points, categorized for the types: CommonGoal, PersonalGoal, Adiajency, Bonus.

---

```
//UpdateScoreMessage.java  
public class UpdateScoreMessage extends  
    ModelMessage<UpdateScorePayload> {  
    public UpdateScoreMessage(Integer score,  
        UpdateScorePayload.Type type, String nickname) {  
        super(new UpdateScorePayload(type, score, nickname));  
    }  
}  
//UpdateScorePayload.java  
public record UpdateScorePayload(Type type, int score, String  
    player) implements Serializable {  
    public enum Type {  
        CommonGoal, PersonalGoal, Adiajency, Bonus  
    }  
}
```

---



## 6 APPENDIX C

- Abstract ViewMessage data structure.

---

```
//ViewMessage.java
public abstract class ViewMessage<Payload extends Serializable>
    implements Serializable {

    private final Payload payload;
    private final String nickname;

    private final int clientId;
    public ViewMessage(Payload payload, String playerNick, int
        clientId){
        this.payload = payload;
        this.nickname = playerNick;
        this.clientId = clientId;
    }
    public Payload getPayload(){
        return this.payload;
    }
    public abstract Class<?> getMessageType();
    public String getPlayerNickname(){
        return this.nickname;
    }
    public int getClientId(){
        return this.clientId;
    }
}
```

---

- Create a new game Lobby with *size* number of player

- Error Reply:

- \* If size < 2 or size > 4 Response:

- [status=-1, msg="InvalidLobbySize"]

- \* If a player with the same nickname is already present:

- [status=-1, msg="Nickname Taken"]

- No Update Reply.

---

```
//CreateLobbyMessage.java
public class CreateLobbyMessage extends ViewMessage<Integer> {
    public CreateLobbyMessage(Integer size, String playerNick, int
        clientId) {
        super(size, playerNick, clientId);
    }
    @Override
    public Class<?> getMessageType() {
        return this.getClass();
    }
}
```

```
}  
}
```

---

- If the nickname matches a player in a RecoveryLobby, join that lobby.
  - Error Reply:
    - \* If the nickname doesn't match any recoverable lobby Response :  
[status=-1, msg="LobbyUnavailable"]
  - Update Reply:
    - \* StartGameMessage

---

```
//RecoverLobbyMessage.java  
public class RecoverLobbyMessage extends ViewMessage<Serializable>  
{  
    public RecoverLobbyMessage(String playerNick, int clientId) {  
        super(null, playerNick, clientId);  
    }  
    @Override  
    public Class<?> getMessageType() {  
        return this.getClass();  
    }  
}
```

---

- Request the information of all the lobbies with *size* size
  - No particular Error reply
  - Update Reply
    - \* AvailableLobbyMessage

---

```
//RequestLobbyMessage.java  
public class RequestLobbyMessage extends ViewMessage<Integer> {  
    public RequestLobbyMessage(Integer size, String playerNick, int  
        clientId) {  
        super(size, playerNick, clientId);  
    }  
    @Override  
    public Class<?> getMessageType() {  
        return this.getClass();  
    }  
}
```

---

- Request to join the lobby with *lobbyId* id.
  - Error reply
    - \* If the lobby is full or an invalid id was sent:  
[status=-1, msg="Lobby Unavailable"]

- \* If the player's nickname is already taken:  
[status=-1, msg="Nickname Taken"]

- Update reply

- \* GameStartMessage

---

```
//JoinLobbyMessage.java
public class JoinLobbyMessage extends ViewMessage<Integer> {
    public JoinLobbyMessage(Integer lobbyId, String playerNick, int
        clientId) {
        super(lobbyId, playerNick, clientId);
    }
    @Override
    public Class<?> getMessageType() {
        return this.getClass();
    }
}
```

---

- Send player move

- Update Reply

- \* BoardMessage
- \* ShelfMessage
- \* CurrentPlayerMessage
- \* CommonGoalMessage
- \* UpdateScoreMessage
- \* EndGameMessage

- Error reply

- \* If the player is not the current player:  
[status=-1, msg="Not the current player : event will be ignored"]
- \* If the move is ill-formed or illegal:  
[status=-1, msg="Illegal move : ignoring player action"]

---

```
//MoveMessage.java
public class MoveMessage extends ViewMessage<Move> {
    public MoveMessage(Move move, String playerNick, int clientId) {
        super(move, playerNick, clientId);
    }
    @Override
    public Class<?> getMessageType() {
        return this.getClass();
    }
}

//Move.java
public record Move(List<Coordinate> selection, List<Tile> tiles,
    int column) implements Serializable {}
```

---

- Send a chat message to another player in the lobby with the nickname *playerDestination*. If *playerDestination* is not provided the server will send the message to all players in the lobby.

- Update Reply
  - \* IncomingChatMessage
- No particular Error Reply

---

```
//ChatMessage.java
public class ChatMessage extends ViewMessage<String> {
    private final String dest;
    public ChatMessage(String s, String playerNick, int clientId) {
        super(s, playerNick, clientId);
        dest = "BROADCAST";
    }
    @Override
    public Class<?> getMessageType() {
        return this.getClass();
    }
    public ChatMessage(String s, String PlayerNick, String
        playerDestination, int clientId){
        super(s, PlayerNick, clientId);
        dest = playerDestination;
    }
    public String getDestination(){
        return this.dest;
    }
}
```

---

## 7 APPENDIX D

Here is a list with the name and descriptions of all the common goals with their ID number

0. [SixGroupTwoTileGoal](#) : "Six groups, each containing at least 2 tiles of the same type."
1. [FourGroupFourTileGoal](#) : "Four groups, each containing at least 4 tiles of the same type."
2. [FourCornersGoal](#) : "Four tiles of the same type in the four corners of the shelf."
3. [TwoGroupSquareGoal](#) : "Two 2x2 squares of tiles of the same type."
4. [ThreeColumnSixTileGoal](#) : "Three columns, each formed by 6 tiles of maximum 3 different types."
5. [EightUniqueGoal](#) : "Eight tiles of the same type, in any position."
6. [DiagonalFiveTileGoal](#) : "Five tiles of the same type forming a diagonal."
7. [FourRowFiveTileGoal](#) : "Four rows, each formed by 5 tiles of maximum 3 different types."
8. [TwoColumnDistinctGoal](#) : "Two columns each formed by 6 distinct types of tiles."
9. [TwoRowDistinctGoal](#) : "Two rows each formed by 5 distinct types of tiles."
10. [CrossGoal](#) : "Five tiles of the same type forming an X shape."
11. [DecreasingColumnsGoal](#) : "Five columns of increasing or decreasing height, with tiles of any type."