# Project Report : P2P File Transfer App

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## Abstract :

The Peer-to-Peer (P2P) File Transfer System is the solution for the effective and safe file exchange between the users in the network. It has both the server and the client part, where the server takes responsibility for receiving and storing files, reconstructing files and the client is responsible for splitting files, transmitting and handling errors. It provides for segmentation of files, dynamic pairing codes for client authentication and utilizes md5 algorithm for verifying data integrity. The system is designed for parallel or simultaneous transfers through multi-thread mode for increased capability. Developed in Java, it also applies key concepts like Object-Oriented Programming (OOP), multi-threading, network I/O, and file I/O.

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## Tools and Technologies :

**Programming Language:** Java
**Frameworks:** Java Swing for GUI development
**Networking:** Java Sockets for communication between peers
**File Handling:** File I/O for storing files.
**Metadata :** Google's Gson library for json file parsing & MD5 algorithm for hashing.
**Tools:** IntelliJ IDEA IDE for development.

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## System Design :

The system is designed using Object-Oriented Programming (OOP) principles to manage peer-to-peer file transfers efficiently. The following are the key components:

1. **FileServer:** The server-side component that listens for incoming client connections, verifies the pairing code, and handles file reception and reconstruction.
2. **FileClient:** The client-side component that connects to the server, handles file splitting into smaller chunks, and sends the chunks to the server.
3. **Utils:** A utility class that provides helper methods for generating random pairing codes and validating IP addresses.
4. **FileServ:** A service class that handles the splitting and rebuilding of files, ensuring that files can be divided into multiple parts and reassembled correctly.

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## Project Structure:

| Class Name | Attributes | Methods |
|---|---|---|
| FileServer | `port: int`<br><br>`serverSocket: ServerSocket`<br><br>`CHUNK_SIZE: int`<br><br>`stat: boolean`<br><br>`pathToSave: String` | `start(): void`<br><br>`stop(): void`<br><br>`handleClient(Socket): void`<br><br>`receiveFile(DataInputStream,DataOutputStream, File, long): void`<br><br>`logMessage(String): void` |
| FileClient | `serverAddress: String`<br><br>`serverPort: int`<br><br>`code: int` | `setCode(int): void`<br><br>`sendFiles(String[] filePaths, String fname, int fileParts):   void`<br><br>`sendFile(String filePath): void`<br><br>`getPaths(String PathT, int segments): String[]` |
| FileServ | `Path: String`<br><br>`segmentCount: int`<br><br>`CHUNK_SIZE: int` | `split(): void`<br><br>`rebuild(String fileName, String filePathToSave): void`<br><br>`deleteS(String tPathofFile, int parts): void`<br><br>`bytesToHex(byte[] bytes): String` |
| Utils | `None` | `randomCode(): int`<br><br>`isValidIP(String ip): boolean` |

| | | |
|---|---|---|
| ReceiverGUI | `pairCodeField: JTextField`<br><br>`saveFolderField: JTextField`<br><br>`console: JTextArea`<br><br>`randomCode: int`<br><br>`path_selected: String`<br><br>`fileServer: FileServer`<br><br>`serverThread: Thread`<br><br>`startButton: JButton` | `createAndShowGUI(): void`<br><br>`startServer(): void`<br><br>`SetMsg(String msg): void` |
| SenderGUI | `console: JTextArea` | `createAndShowGUI(): void`<br><br>`validateAndSend(String ip, String filePath, int threads, String pairCode): void`<br><br><br>`log(String message): void` |
| FileTrasnsfer | None | `FileTrasnsfer(): void`<br><br><br>`createAndShowGUI(): void`<br><br>`main(String[] args): void` |

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## Relationships & workflow :

1. **FileServer Class** communicates with the **FileClient** to handle file transfers.
2. **FileServer** uses the **FileServ** class for file operations like receiving and rebuilding files.
3. **FileClient** works with the **FileServ** class to split large files and send them in parts.
4. **FileServer** and **FileClient** both interact with **GUI classes** (FileTrasnsfer, SenderGUI and ReceiverGUI) to provide a graphical interface for users.
5. **FileServ** handles file operations like splitting, rebuilding, and deleting segments of files.
6. **Utils** provides helper methods for the system, like generating random codes and validating IP addresses.

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## Highlights :

During project development I faced some difficulties & while solving them I learned some new topics too. I'm listing them here :

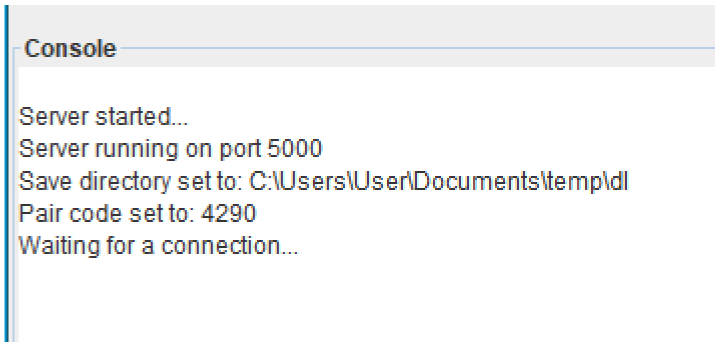
1. **Rebuilding issues :**
   While writing the FileServ class (It's a short form for File Service) I encountered a weird bug which was a segmentation issue. Each file was missing around 1024 bytes of data from the beginning of the file. Changing the read/write size higher than 1024 solved it. Java often messes up if you read/write with a small amount of buffers.

2. **EOF Handling :**
   As I was using multiple threads to send multiple files, I needed to tell the server to close the connection & start rebuilding when all the parts were sent. But in multi threading each thread doesn't run by order, it runs by memory usage. So, the end signal was sent before the file transfer was even completed. After doing some research I learned about Java latch, which makes thread wait until a thread is completed. So I implemented it & finally the problem was solved, Here's the implementation snapshot:

```
// ref : https://www.baeldung.com/java-countdown-latch
public void sendFiles(String[] filePaths,String fname, int fileParts) {
   // latch insertion with total file count as thread count
   CountDownLatch latch = new CountDownLatch(filePaths.length);
   for (String filePath : filePaths) {
      new Thread(() -> {
           try {
               sendFile(filePath);
           } finally {
               latch.countDown(); //after starting file thread add countdown
           }
       }).start();
   }

// end thread that sends EOF to server as -9999
   new Thread(() -> {
       try {
           latch.await(); //start when other threads are finished
           try {
              // rest of my code
           } catch (Exception e) {
               e.printStackTrace();
           }
       } catch (InterruptedException e) {
           e.printStackTrace();
       }
   }).start();
}
```

3. **Printing Status message to GUI :**
   It took me some time to figure out that I can keep the console public and pass a log function to my backend classes to show on GUI.



```
Server started...
Server running on port 5000
Save directory set to: C:\Users\User\Documents\temp\dl
Pair code set to: 4290
Waiting for a connection...
```

   It finally worked after some digging

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## TO-DO (Future development of this project) :

1. Implement encryption.
2. Developing an android application. (Under development)
3. Multi threading based file splitting.
4. Check available space before splitting.
5. Progressbar GUI.
6. More efficient error handling (Current one has some lackings)

All the updates can be found here : https://github.com/Rhythm113/CSE215L.git

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