

P2P File Sharing Application Report

Cedric Bone
Rochester Institute of Technology
Rochester NY, U.S.A
cb9017@rit.edu

1 Introduction

This peer-to-peer (P2P) file-sharing application lets users (peers) on a network discover each other, search for files shared by other peers, and download files directly from them in a decentralized way. The implementation was inspired from the BitTorrent protocol and has chunked file transfers.

2 Features

The app includes:

- **Peer Discovery:** Manual connection between peers using IP address and port
- **File Indexing:** Each node indexes files periodically (15 seconds)
- **File Searching:** Peers can search for files across the network of connected peers. Results show the filename, size, and the peer hosting the file
- **Chunked File Transfer:** Files are downloaded in fixed-size chunks (64KB)
- **File Integrity Verification:** SHA-256 hashing is used to verify that downloaded files match the original
- **Concurrent Connections:** Uses threading to handle multiple connections plus background tasks at the same time

3 Implementation

Each instance is a client and a server and communication uses TCP sockets. Requests and responses are JSON strings.

- `node.py`: Main class, has node's logic (connections, indexing, requests, and downloads)
- `cli.py`: Handles user interaction

- `main.py`: Starts everything
- `utils.py`: Has a helper function (had more initially)

3.1 File Indexing

index_files scans the shared directory, calculates the size, number of chunks, and the hash for each file

3.2 Chunk Transfer

When downloading the node requests file info, then iterates through the chunks

3.3 Concurrency

start_server Each connection is handled by making a new thread. Indexing also has a thread

4 Overview

The protocol follows these steps:

- Client requests file information (size, hash, number of chunks)
- Client requests each chunk separately
- After all chunks are downloaded, file integrity is verified using SHA-256 hash
- If verification succeeds, the file is saved to the shared directory

While both are P2P this implementation is different from BitTorrent:

- manual port connection VS automatic peer discovery
- file info (size, hash) with JSON VS bencoded metainfo
- sequential chunks VS piece selection
- hash integrity for whole-file VS for individual pieces

5 Use

5.1 Starting a Node

A node is started by specifying the directory to share:

```
python main.py --dir ./directory_path
```

```
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared1

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 1 files

> Listening on port 60744
Indexed 1 files
Indexed 1 files
Indexed 1 files
connect 127.0.0.1 60771
Added peer: 127.0.0.1:60771
Connected to: 127.0.0.1:60771

> Indexed 1 files
█

~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
Last login: Sun Apr 13 19:26:03 on ttys072
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
█
```

Figure 1: Starting P2P nodes

5.2 Connecting Peers

Connecting uses the *connect* command in the CLI, followed by the peer's IP and port:

```
connect ip_address port
```

```
x ~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
Last login: Sun Apr 13 19:26:03 on ttys072
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
Indexed 0 files
list

Local files:
> █

x ~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared1

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 1 files

> Listening on port 60744
Indexed 1 files
Indexed 1 files
Indexed 1 files
connect 127.0.0.1 60771
Added peer: 127.0.0.1:60771
Connected to: 127.0.0.1:60771

> Indexed 1 files
Indexed 1 files
Indexed 1 files
list

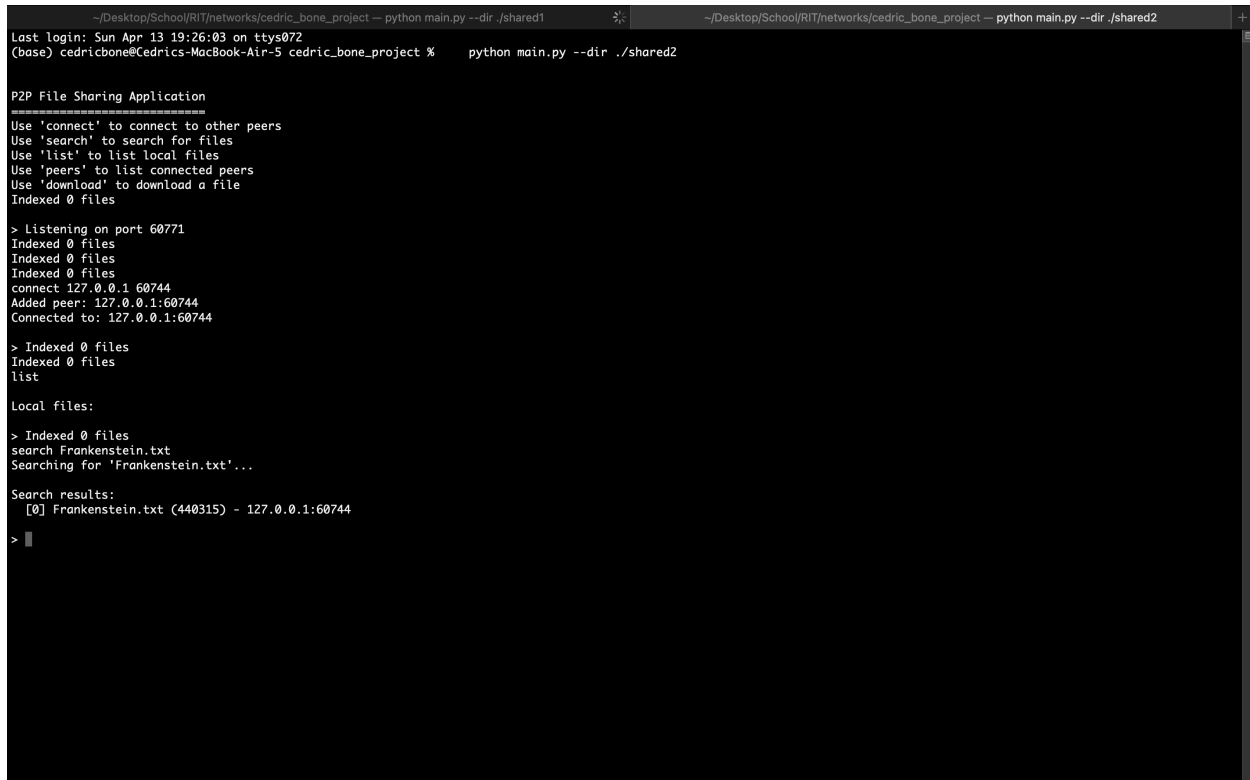
Local files:
Frankenstein.txt (440315)
> █
```

Figure 2: Connecting Nodes

5.3 Searching for Files

Use the *search* command:

```
search filename
```



```
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1  3/4  ~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2  +
Last login: Sun Apr 13 19:26:03 on ttys072
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
Indexed 0 files
list

Local files:

> Indexed 0 files
search Frankenstein.txt
Searching for 'Frankenstein.txt'...

Search results:
[0] Frankenstein.txt (440315) - 127.0.0.1:60744

> █
```

Figure 3: Searching for Frankenstein

5.4 Downloading Files

Use the *download* command with the index number from the search results:

```
download index_number
```

```
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared1
~/Desktop/School/RIT/networks/cedric_bone_project -- python main.py --dir ./shared2
(base) cedricbone@Cedrics-MacBook-Air-5 cedric_bone_project % python main.py --dir ./shared2

P2P File Sharing Application
=====
Use 'connect' to connect to other peers
Use 'search' to search for files
Use 'list' to list local files
Use 'peers' to list connected peers
Use 'download' to download a file
Indexed 0 files

> Listening on port 60771
Indexed 0 files
Indexed 0 files
Indexed 0 files
connect 127.0.0.1 60744
Added peer: 127.0.0.1:60744
Connected to: 127.0.0.1:60744

> Indexed 0 files
Indexed 0 files
list

Local files:

> Indexed 0 files
search Frankenstein.txt
Searching for 'Frankenstein.txt'...

Search results:
[0] Frankenstein.txt (440315) - 127.0.0.1:60744

> Indexed 0 files
download 0
Downloading 'Frankenstein.txt' from 127.0.0.1:60744...

> Downloading chunk 1/7 (14.285714285714285%)...
Downloading chunk 2/7 (28.57142857142857%)...
Downloading chunk 3/7 (42.857142857142854%)...
Downloading chunk 4/7 (57.14285714285714%)...
Downloading chunk 5/7 (71.42857142857143%)...
Downloading chunk 6/7 (85.71428571428571%)...
Downloading chunk 7/7 (100.0%)...

calc hash: f497cabfcd2fa811c58d313a96cf1171c835b8b317a29afaf3ced224101618e2 expected hash: f497cabfcd2fa811c58d313a96cf1171c835b8b317a29afaf3ced224101618e2
Indexed 1 files

Downloaded Frankenstein.txt
```

Figure 4: Downloading a file, showing chunk progress (Frankenstein was downloaded from Project Gutenberg)