UNIVERSITY OF SCIENCE AND TECHNOLOGY OF HANOI

REPORT

Subject: Network Programming

Implementation of Multi-Node File Storage System

Class: B2 - CS

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1. Introduction

This project implements a Multi-Node File Storage System that enables file upload, download, listing, and deletion through a centralized index server. The system leverages multiple storage nodes for distributed file storage and replication, ensuring redundancy, integrity, and accessibility of files.

2. System Components

a. Index Server (index_server.js)

- Acts as the central coordinator.
- Maintains metadata of files and mapping to storage nodes.
- Handles client requests for upload, download, listing, and deletion.
- Manages communication with storage nodes using WebSocket.

b. Storage Nodes (servernode.js)

- Registers with the index server.
- Stores file data locally in a data/ directory.
- Responds to file retrieval and deletion requests.
- Sends acknowledgments for storage operations.

c. Client (client.js)

- Provides a command-line interface.
- Connects to the index server via WebSocket.
- It supports commands: upload, list, download, and delete.
- Manages local file operations and communicates using JSON messages.

3. Features Implemented

- Index Server (index-server/): tracks metadata and node registry and coordinates replication.
- Storage Nodes (storage-node/): register themselves, store files under data/, handle store/retrieve/delete.
- Client (client/): CLI is used for uploading, listing, downloading, and deleting.
- **File Upload:**
    - Clients upload files to the index server.
    - Files are assigned a unique file ID.
    - The file is replicated to multiple storage nodes (default: 3).

- **File Download:**
  - Clients download files using file IDs.
  - Files are retrieved from one of the replicated nodes.
- **File Listing:**
  - Clients can list all available files with metadata.
- **File Deletion:**
  - Files can be deleted from all nodes, and the metadata removed from the index server.
- **File Replication:**
  - Ensures fault tolerance by storing files on multiple nodes.
- **Checksum Verification:**
  - Used to verify the integrity of stored and transferred files.
- **Command-Line Interface:**
  - User-friendly interaction for managing files.

Distribution Algorithm

- On upload, the index server picks the first N=3 registered nodes.
- Sends full file data over WebSocket to each.
- Waits for **STORE_ACK** from all before confirming to the client.

Node Selection

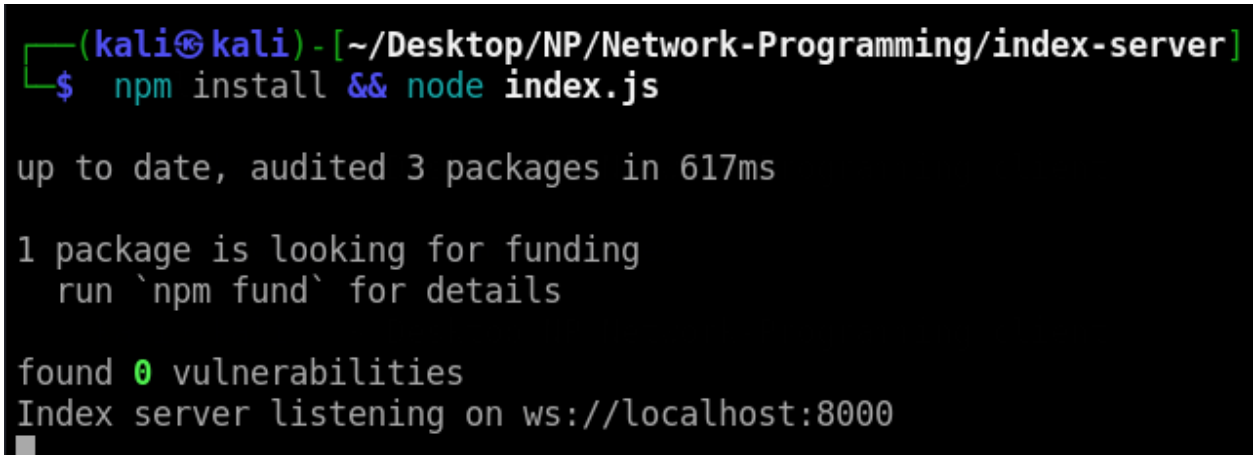
- Currently, it uses simple FIFO selection of the first N nodes.
- Can be extended with latency measurements or geo-location.

4. Usage

!! Create 3 separate terminals

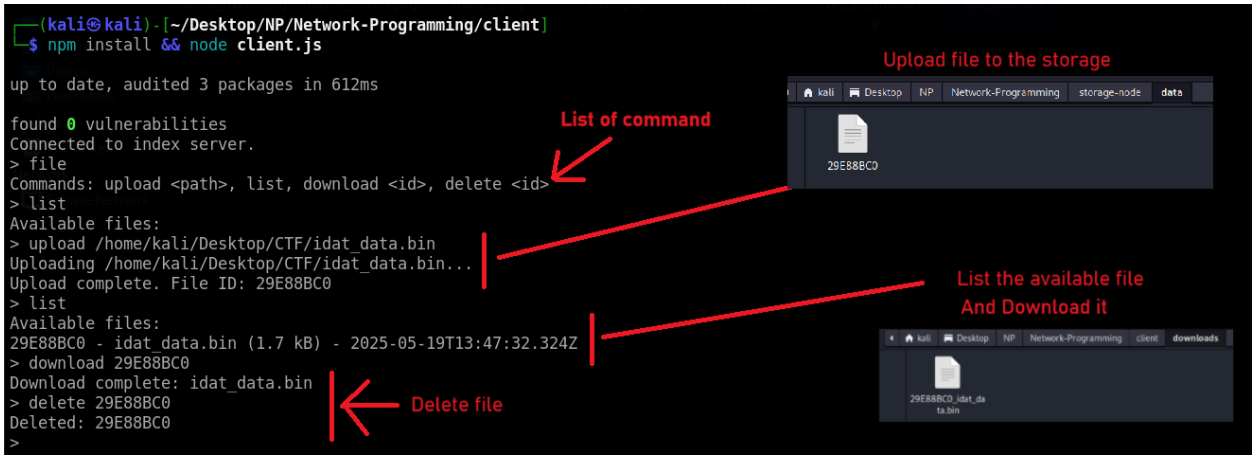
1. For the **index server**:
   cd index-server && npm install && node index.js
2. For each **storage node**:
   cd storage-node && npm install && node storageNode.js <NODE_ID>
3. For **client** terminal:
   cd client && npm install && node client.js
4. From client prompt:
   upload <file> (file uploaded in /storage-node/data)
   list
   download <id> (file downloaded in /client/downloads)
   delete <id>

5. Demo



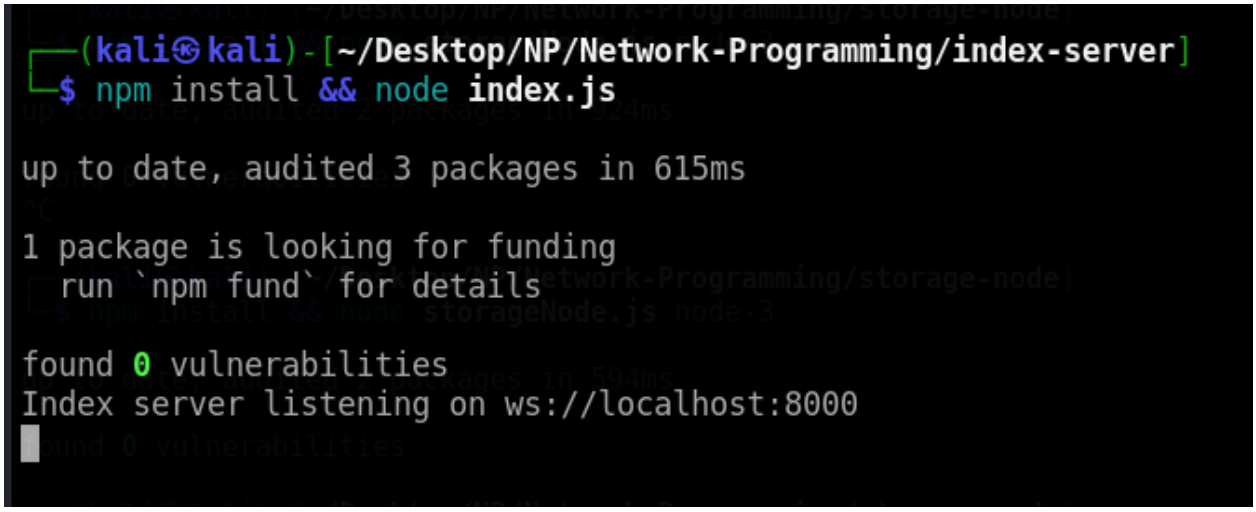
– Start index server –

– Start Storage Node –

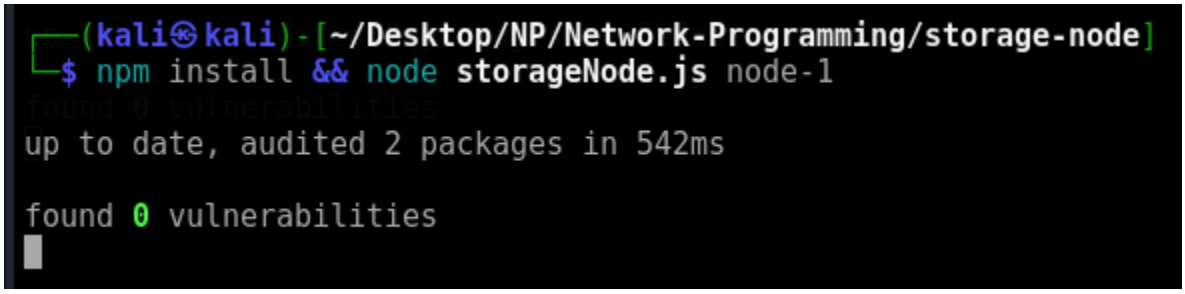


– Run the client and demo –

Demo that the file will be saved in 3 different nodes

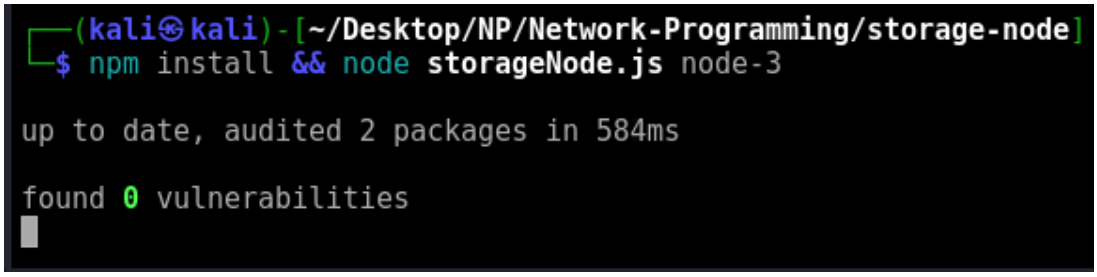


– Start index server –

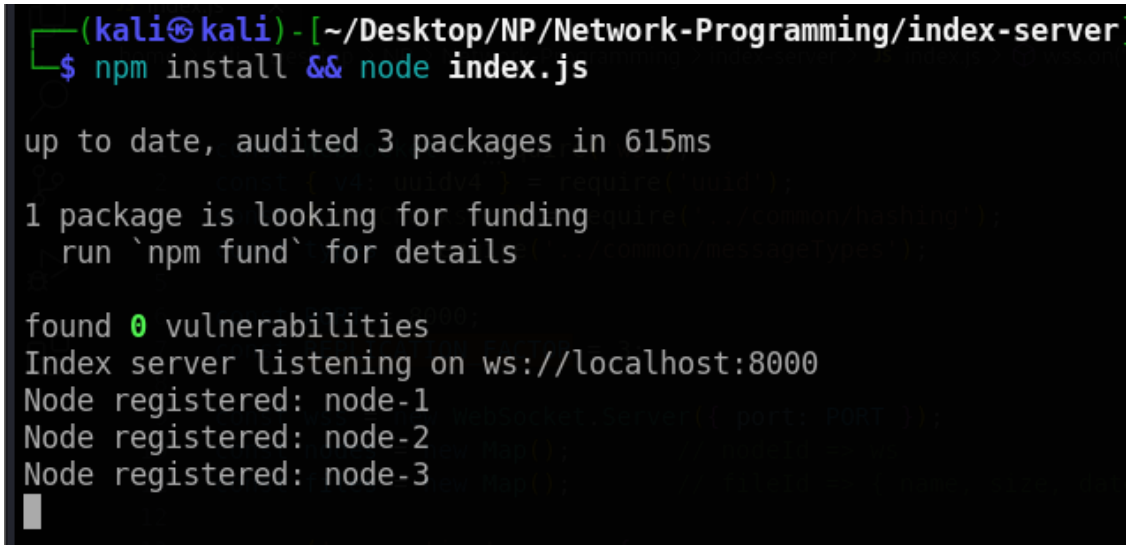


– Start node 1 –

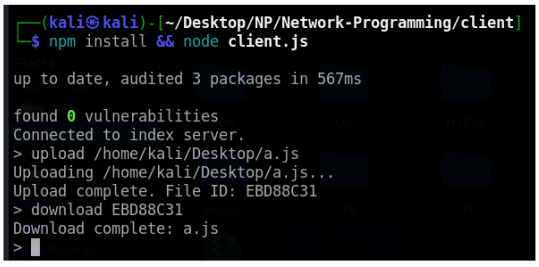
– Start node 2 –



– Start node 3 –



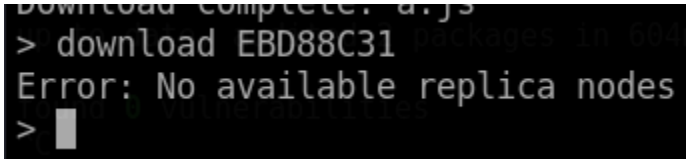
– After that, the server will register 3 nodes –



If there are 3 running storageNode
-> Can download -> File is still available

– If 3 nodes are running –

– If we make 1 node crash –



– If all of the nodes are crashed –