Decentralized File Storage (Mini IPFS)

Building a Resilient P2P Student Cloud

Chapter 1: The Problem with Centralized Systems

Single Point of Failure

If one central server goes down, the entire system and all data become inaccessible.

High Costs and Maintenance

Central servers require expensive infrastructure, maintenance, and complex scaling efforts.

Slower Retrieval

Data traffic often gets routed through long distances, increasing latency for global users.

What is Peer-to-Peer (P2P) Networking?

Direct Connections

P2P connects users (peers) directly, without relying on a single, centralized server.

A Simple Analogy

It's like sharing a document with your study group instead of emailing it to a single library server.

Shared Resources

Every computer in the network contributes storage and bandwidth, making the system robust.

Introducing IPFS: The Web's Next Layer

InterPlanetary File System (IPFS)

- A protocol for storing and accessing files using a content-addressed, decentralized web.
- It finds files based on *what* they are (their content) rather than *where* they are (a server location).
- IPFS is used to build resilient, distributed applications that resist censorship and single points of failure.

Chapter 2: How Mini IPFS Works

Our Mini IPFS site simplifies file sharing through four key stages:

File Upload

A student uploads a large file (e.g., a project report) via the web interface.

Split and Hash

The file is automatically broken into smaller chunks and cryptographically hashed for security.

Distribute and Store

These chunks are distributed and replicated across multiple participating student nodes (storage providers).

Retrieve and Reassemble

When accessed, the file chunks are retrieved from the nearest nodes and reassembled instantly.

Core Architecture Concepts

Nodes

Any computer (student laptop) running the Mini IPFS software, storing and serving file pieces.

Hashing

Every file or chunk gets a unique "fingerprint" based on its content, ensuring data integrity.

Content ID (CID)

The hash is converted into the CID, which is the permanent address used to locate the file.

Sharing Link

Students share the CID, which acts as a permanent, global link for anyone to access the file.

Key Benefits of Decentralized Storage

Reliability

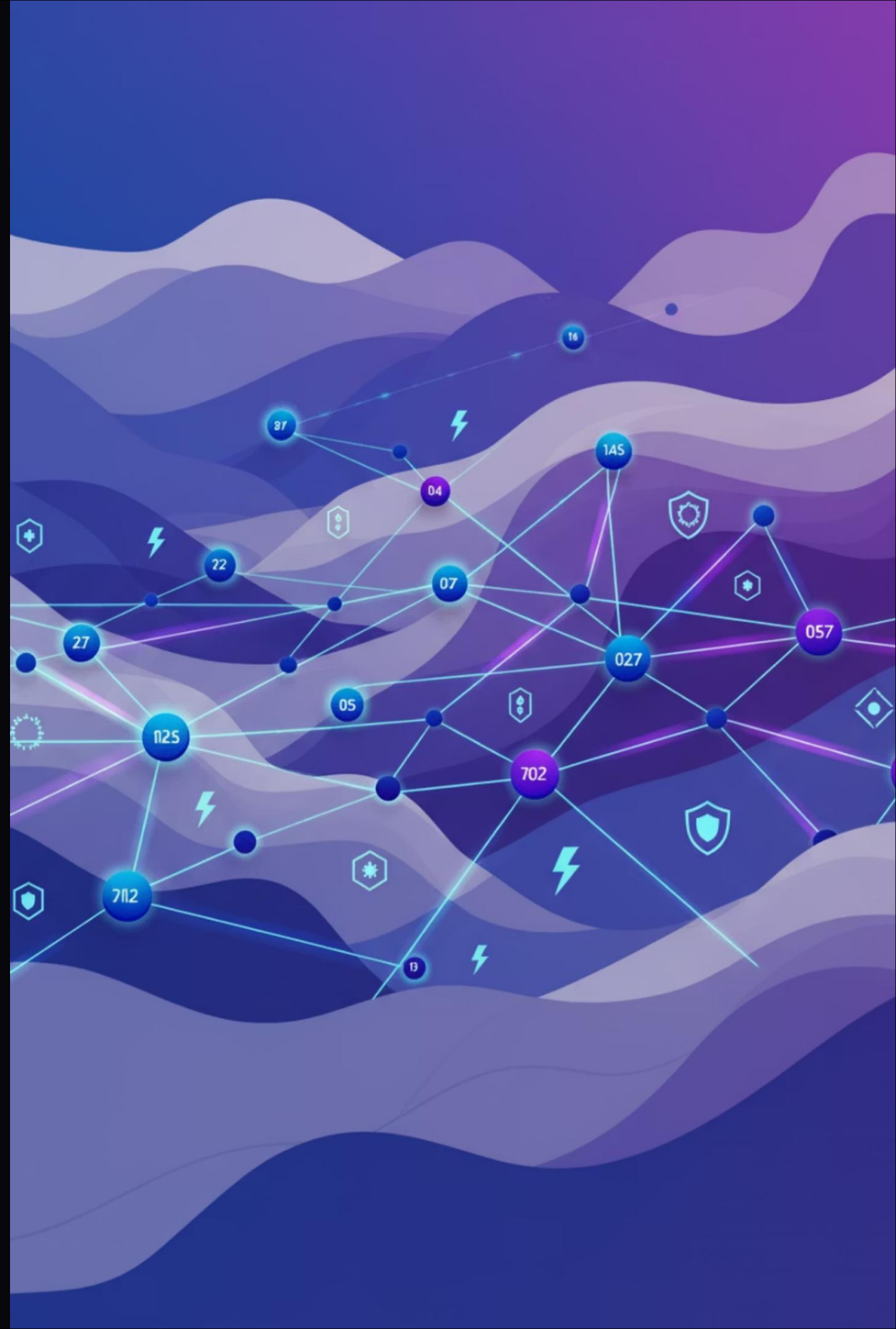
Files are replicated across many nodes; if one fails, the others still hold the data.

Decentralization

No single entity controls the data, promoting greater freedom and resisting censorship.

Increased Speed

Data is pulled from the nearest available node, often reducing loading times dramatically.



Use Case: The Student Collaboration Platform

Easy Access for Academic Files

Students upload large research papers or project videos. The platform sends the files to the Mini IPFS network.

To retrieve, a student only needs the unique CID. The system quickly locates all chunks across the peer network and stitches the file back together.

This ensures resources are available and shared effectively among the academic community.

Tech Stack for Beginners

The system uses simple, modern tools to manage the decentralized backend and user interface.

Backend/Logic

Using familiar languages like `Node.js` or `Python` to handle file processing and communication with the IPFS network.

Decentralized Layer

The core functionality is enabled by an `IPFS API`, allowing us to pin, retrieve, and manage files on the network.

User Interface

A simple `Web UI` (HTML/CSS/JavaScript) provides an intuitive, drag-and-drop experience for uploading and sharing.

Next Steps: Challenges and Future Scope

Immediate Challenges

- Ensuring data persistence: nodes must stay online or files must be "pinned" to dedicated storage.
- User experience: simplifying the concept of CIDs and decentralized access for new users.

Future Scope

- Scaling the network to handle thousands of users and petabytes of data.
- Implementing advanced encryption and zero-knowledge proof for enhanced data privacy and security.
- Adding an incentive layer to reward students who contribute their storage and bandwidth.

THANK YOU