An improved P2P File System Scheme based on IPFS and Blockchain

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Introduction

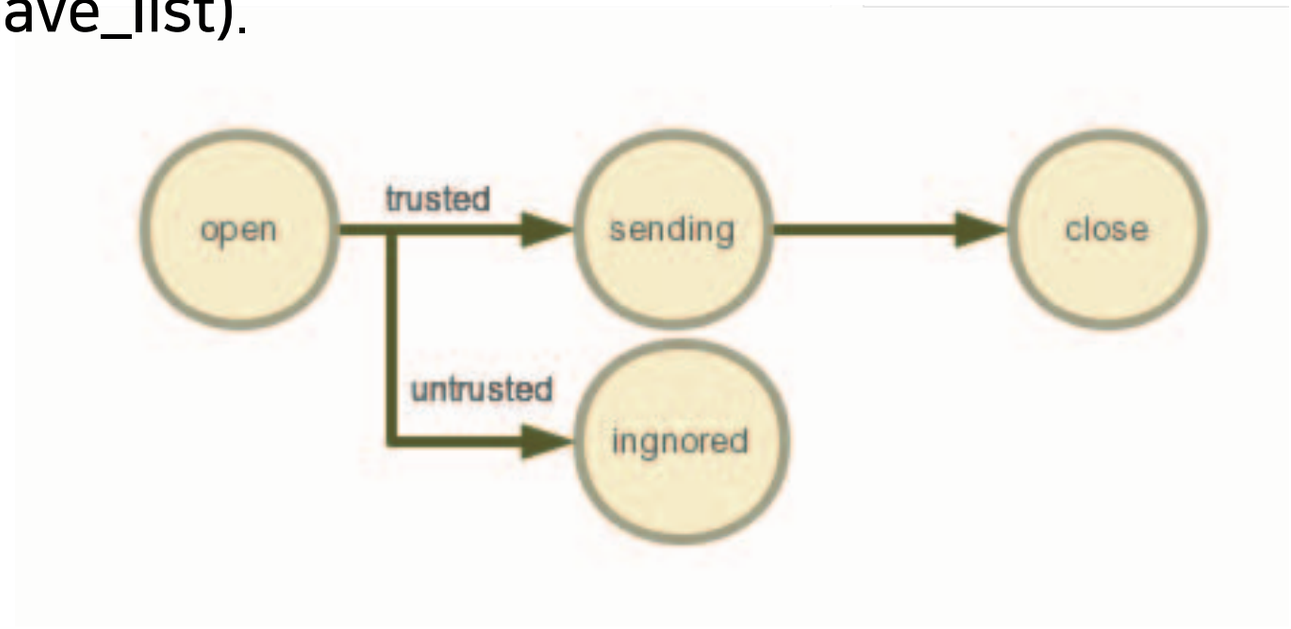
- IPFS is a **peer-to-peer version controlled filesystem** that synthesizes learnings from many previous successful systems.
- However, lots of data transfer everywhere and it is quite difficult to make version control over these data. IPFS does not take into account **the special circumstances of large content service providers.**
- Thus, We propose a scheme that combines **three replication scheme** and **erasure codes** storage scheme.

IPFS

- IPFS represents the **InterPlanetary File System**, which is a peer-to-peer distributed file system, aims to replace HTTP.
- IPFS synthesizes many of the best ideas from the most successful systems to date.
- **BitSwap Protocol** is one of the best ideas they think makes IPFS different from other block storage distributing system.

BitSwap

- BitSwap Credit is a simple credit-like system which solves **the problem of free-loading but never sharing.**
- They introduce **debt ratio** in BitSwap Strategy and the debt ratio becomes a measure of trust which incentivize nodes to exchange a lots of data.
- BitSwap Ledger is very important to a connection between BitSwap peers.
- In the lifetime of a peer connection, BitSwap peers are looking to acquire a set of blocks **(want_list)**, and have another set of blocks to offer in exchange **(have_list)**.

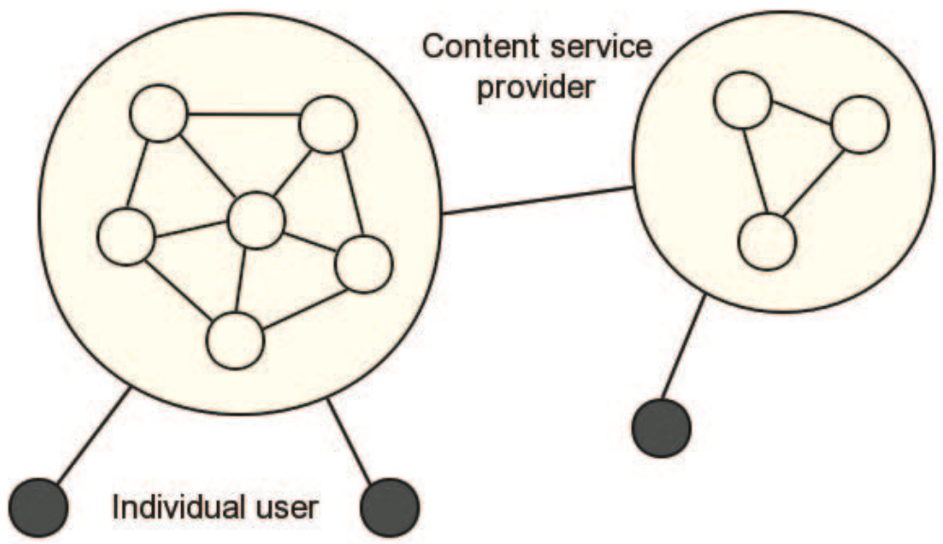


Motivation

- IPFS was originally designed to rely on high throughput to deliver data, but **for personal computers, this is a bit inappropriate.**
- First of all, service providers cannot rely solely on other people to provide content to their customers, which is very unwise for business.
- **Once they lose the data, they lose the customers.**
- Service providers need to store large amounts of data because of their role in the service market and data storage scheme becomes important consequently.
- IPFS provides a block storage mode, **which is very vulnerable to lose data reliability and availability when servers of IPFS break down.**

System Model

- **Service providers** need to maintain one or more nodes to protect the availability of their services, but **individual users** do not bother to do that.
- They can easily choose to join a service provider's network and take the service provider as a proxy node.
- Individual users only need a client, which can be a simple browser, to possess a series of data exchange functions, such uploading and downloading.



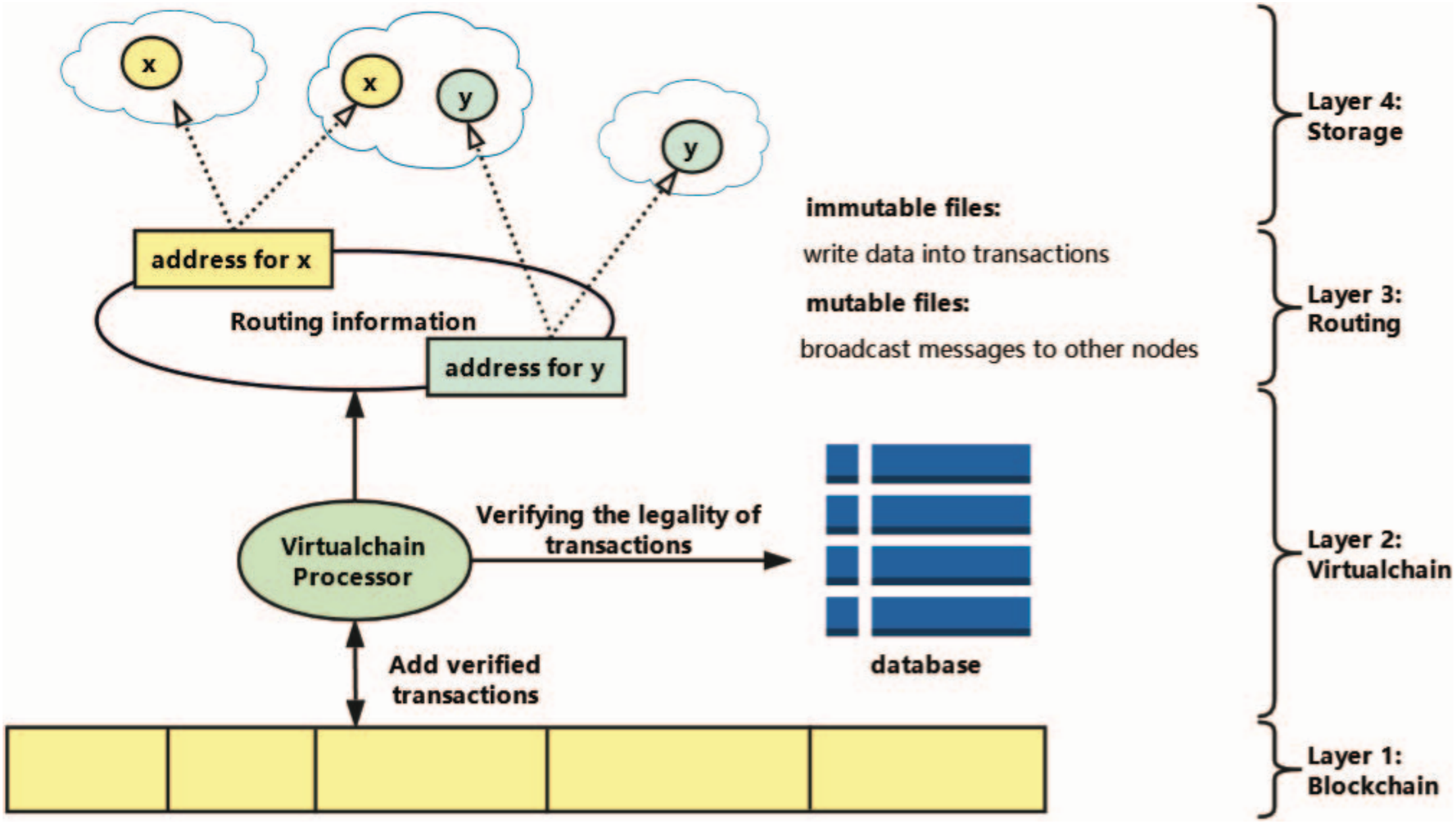


Figure 3. Overview of novel scheme architecture

Data Storage Scheme

- BitSwap peers are looking to exchange blocks in two lists and these blocks can be any part of any files.
- **Based on the frequency of data usage**, we can fairly give definitions of hot data and cold data.
- Hot data is what is read or written more than ten times per 90 days.
- Cold data is the opposite, this rule can also be modified according to the actual situation.
- If blocks are judged as hot data, they will be stored in **three replication scheme**, otherwise they will be stored in **erasure codes storage scheme.**

Erasure codes

- In traditional erasure codes, we need to divide files into blocks and encode them.
- However, in this scheme, we only need to encode blocks directly because all kinds of files have **already been divided into blocks in BitSwap protocol.**
- In traditional (n, k) erasure codes, there are k data blocks and n-k parity blocks.
- It is data blocks that are exchanging in BitSwap protocol, so when one data block is lost, we can immediately repair that data block to continue the protocol.
- This scheme employ **zigzag code.**

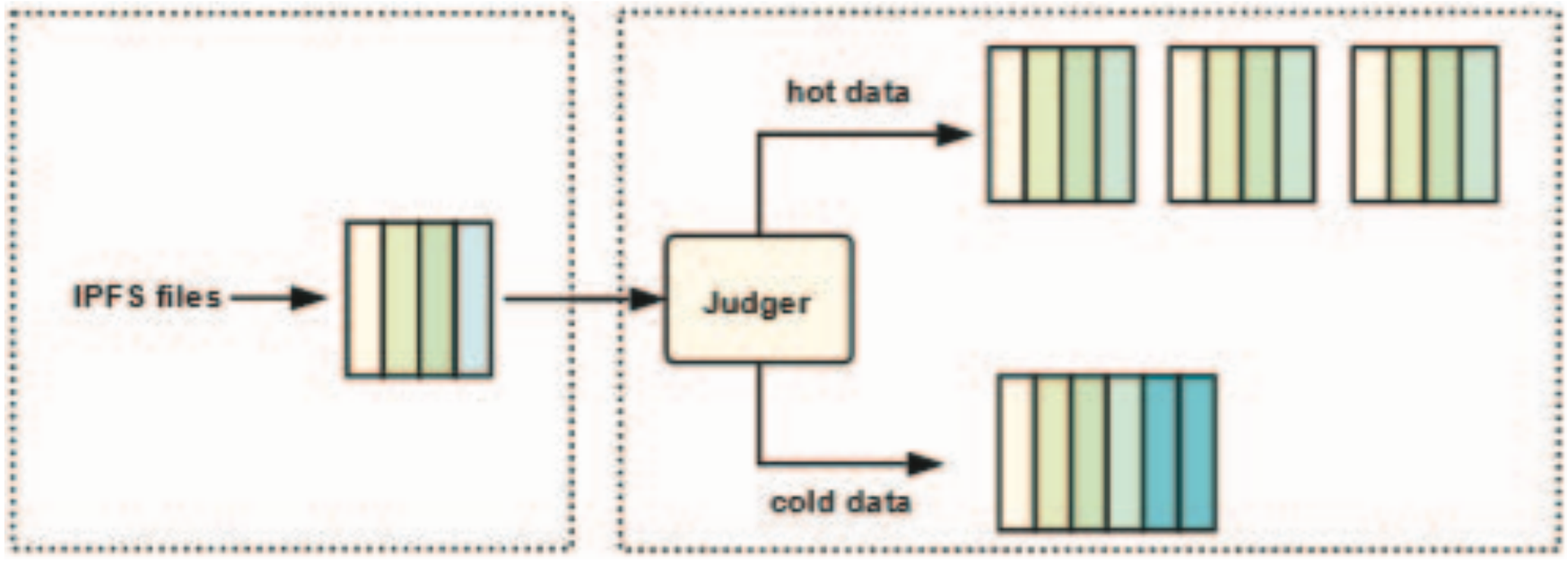


Figure 4. Flow chart of Data Storage Scheme

Advantage of this Scheme

- In our scheme, each node can maintain blocks information of all the other nodes in the local storage or obtain that directly from other nodes so that it **does not need to confirm the want_list after peers have established connection.**
- They can send blocks straightforward to **speed up data exchange.**
- After the transmission of blocks, users can compute the hash of block to verify it matches the expected one regardless of whether there are **malicious nodes or not.**

Evaluation

- This scheme especially customized for large service providers is not only beneficial to them but also to the customers.
- In this scheme, bandwidth occupancy will only increase **if you interact with content service providers to download or upload something.**

Figure 5. Bandwidth

Result of adding Blockchain to Scheme

- The process of establishing a connection between nodes in the network becomes simple.
- Because communication becomes no longer frequent and the required data can be **obtained directly from blockchain.**
- So nodes in the network of our scheme can focus more on the data exchange than on the establishment of communication connections.

Conclusion

- This paper introduces a novel scheme which have made some improvements to the IPFS architecture.
- With this scheme, individual users can no longer suffer from **high throughput issues** and content service providers can better interact with and benefit from the network of this scheme.
- It added a **blockchain** to the original IPFS so that **each node's information can be saved to the blockchain.**
- Future work is to study other modules of IPFS and then do some depth customization optimization for content service providers.