# London Ethereum Meetup

## swarm and web3

9th June 2016

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A brief history of:

# Web Hosting and Incentivisation

Web 1.0

- Start a web server
- Upload content

1. Content is unpopular
   - pay costs of maintaining webserver
2. Content becomes popular
   - bandwidth costs skyrocket
   - server crashes / goes offline

...but at least you owned your own content.

A brief history of:

# Web Hosting and Incentivisation

Web 2.0

- Upload content to the 'cloud'
  - cheap/free
  - scalable

But…

- Content owned by the service providers
- All users are tracked and spied on; providers profit off the data.
- Centralised control: surveillance and censorship.

# A brief history of:
# Web Hosting and Incentivisation

Peer to Peer Networks

eg. Bittorrent

- Content is distributed among peers
- Distribution scales automatically
- Hashing ensures data integrity
- No central point of failure / no servers

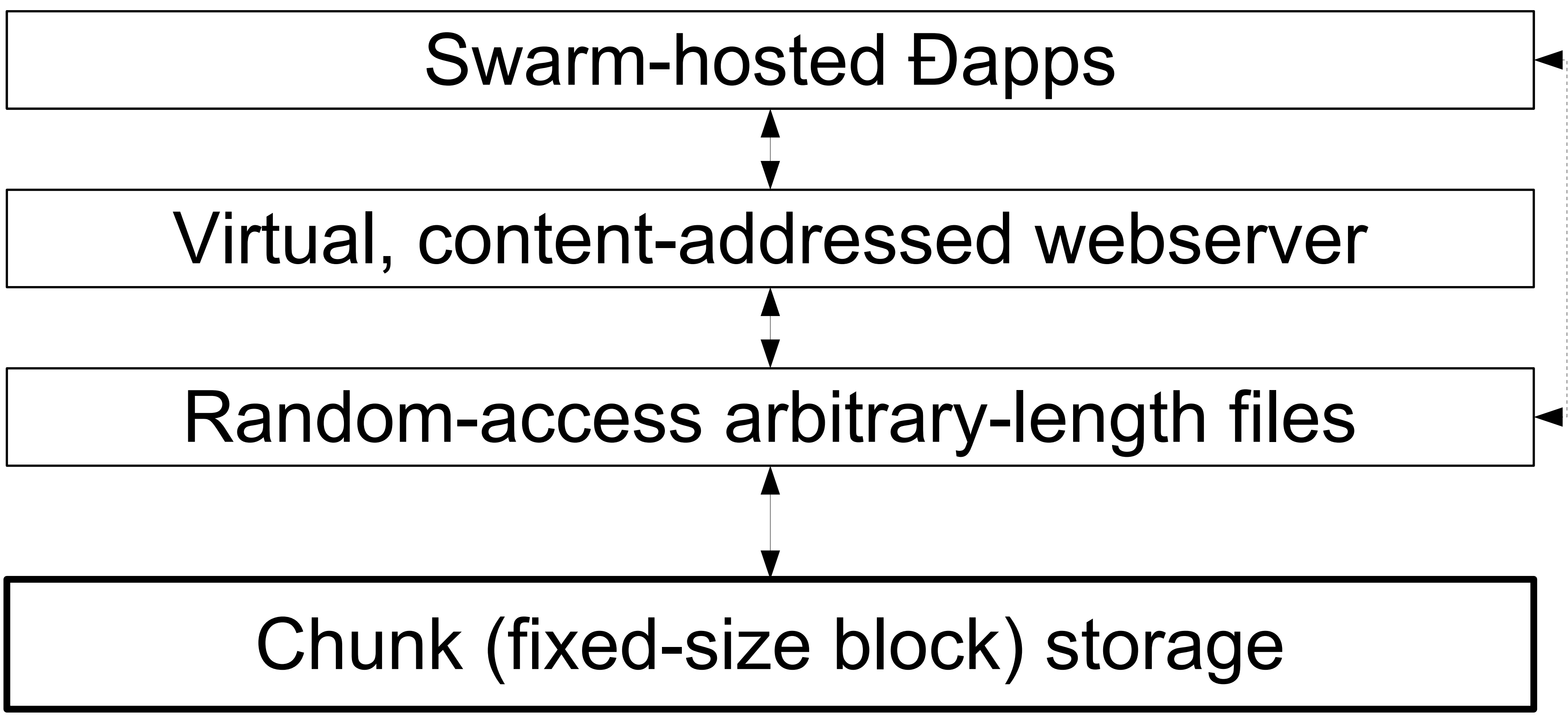
But:

Downloads start slowly (high latency)

No incentive to provide content: “seeding”

# swarm: Basic architecture

Well-separated layers connected by simple APIs:

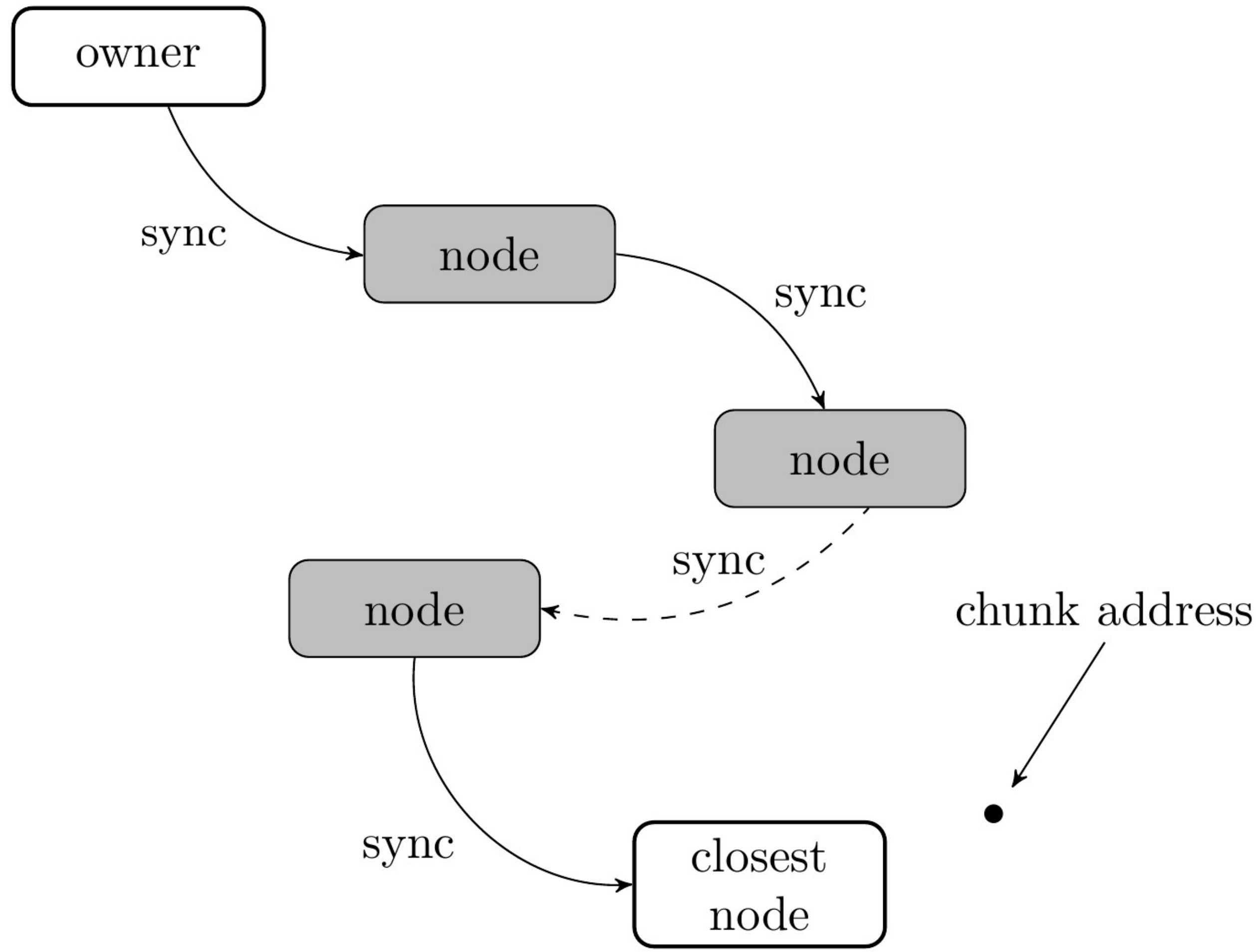


# A (very) quick) introduction to Swarm

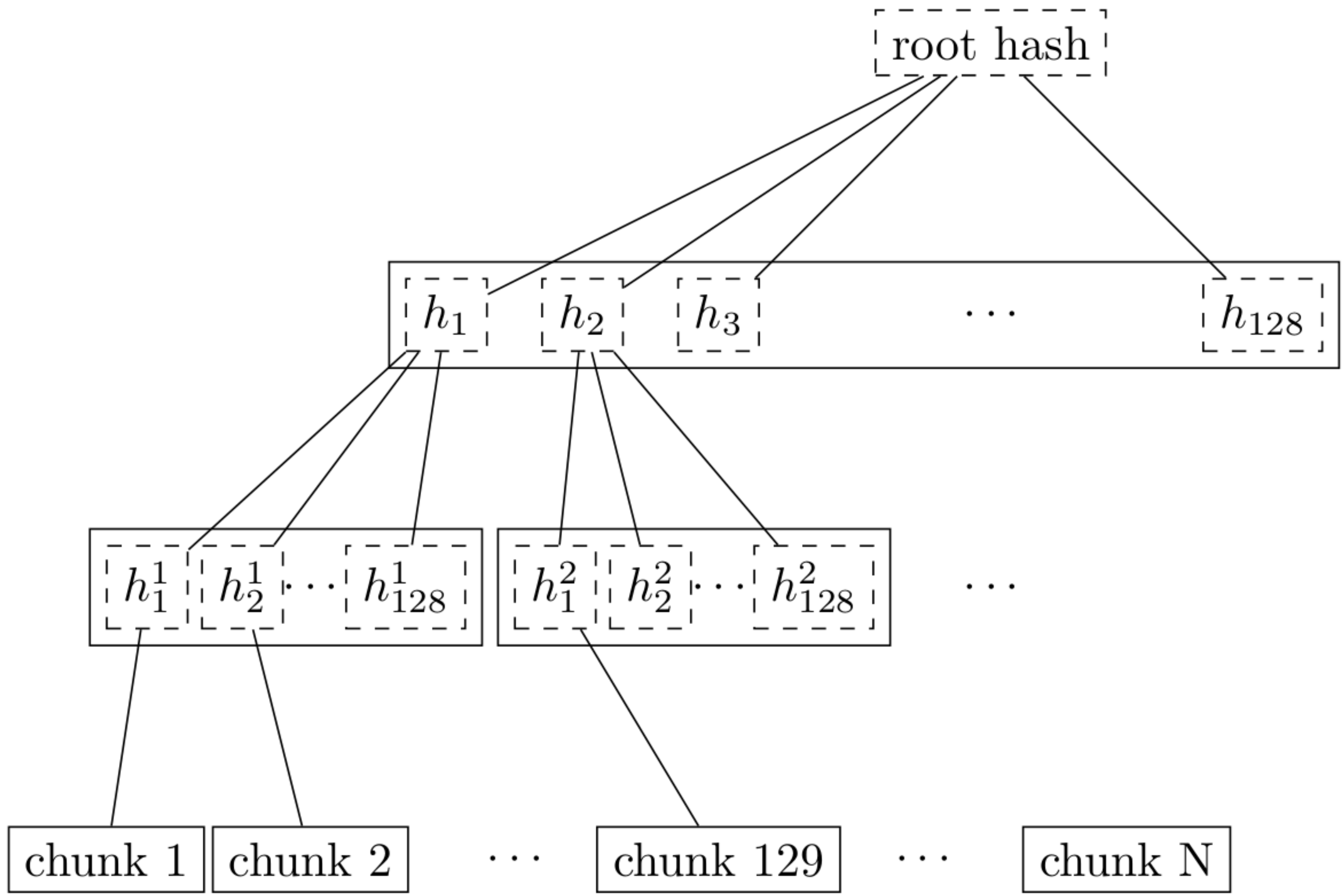
1. Get data into the swarm

# A (very quick) introduction to Swarm

- Data is chopped up into chunks.
- Chunks are forwarded node-to-node (sync)
- Chunks end up with node whose address is closest to chunk hash



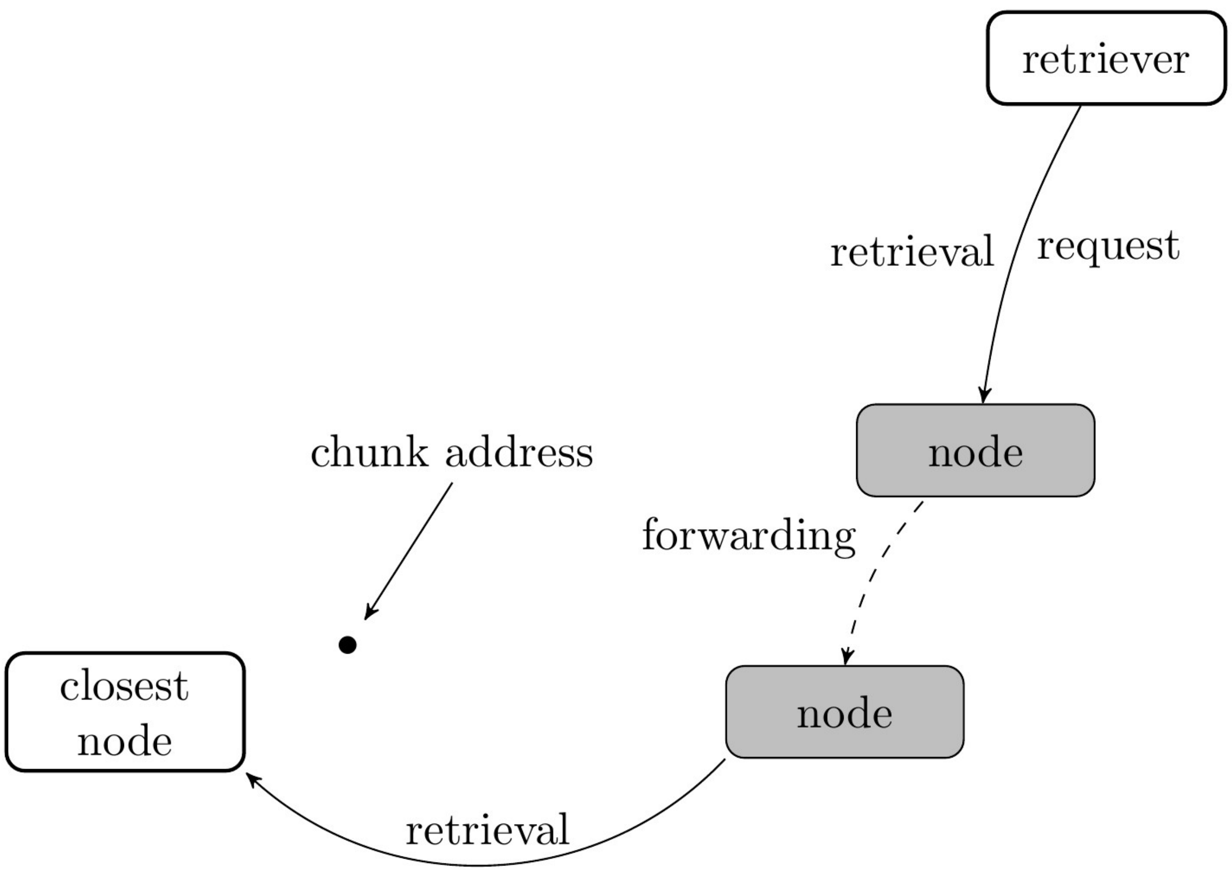
# Ordinary Swarm Chunk Merkle Tree



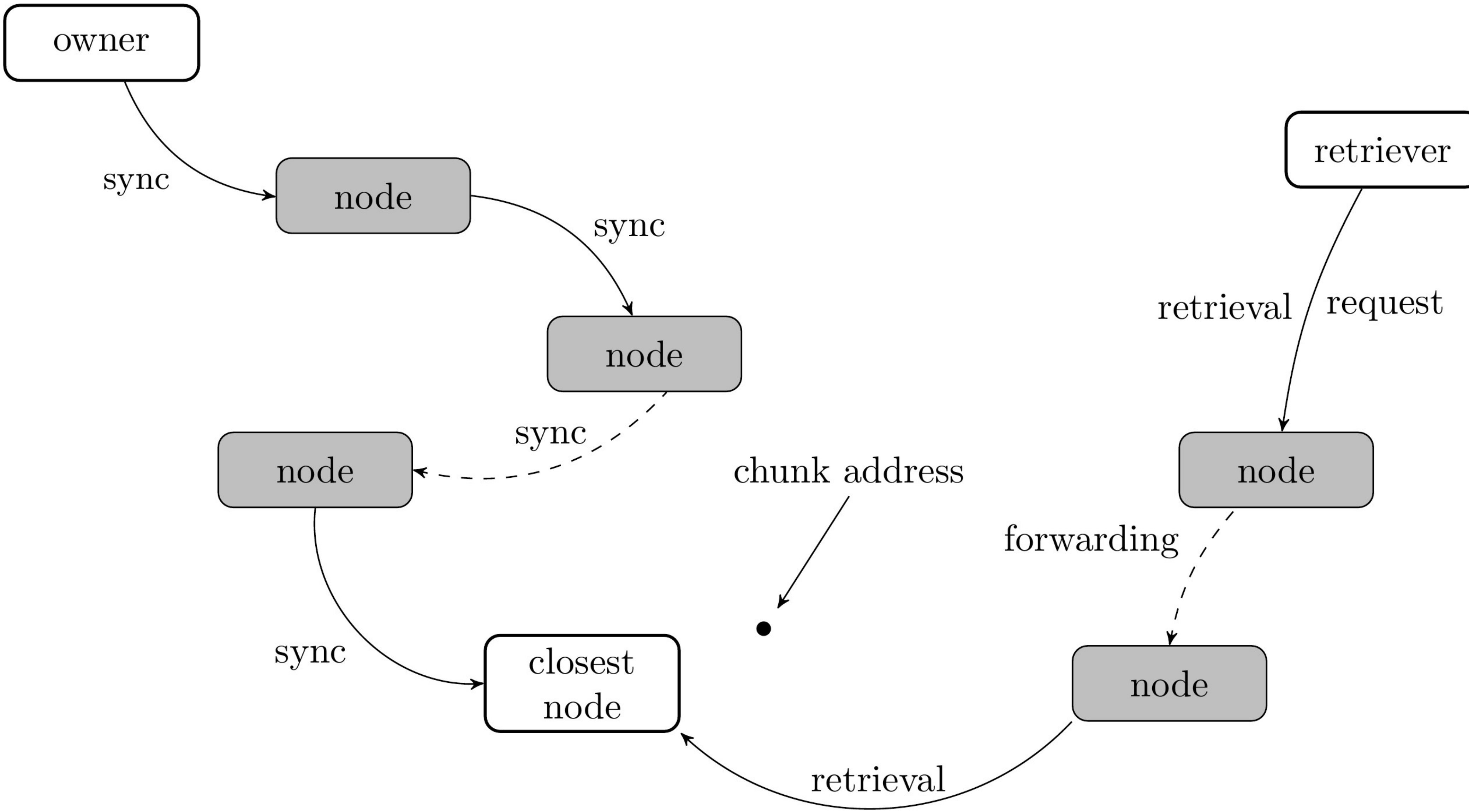
# A (very quick) introduction to Swarm

2. Get data out of the swarm

# A (very quick) introduction to Swarm




- Retriever makes a request to a closer connected node
- Nodes pass on requests
- Forwarding ends when chunk is found. Chunk is passed back.


owner
sync
node
sync
node
sync
node
sync
closest node
chunk address
retriever
retrieval
request
node
forwarding
node
retrieval

# SWAP • SWEAR • SWINDLE

## incentivisation in SWARM

# Swarm Incentive System

## Bandwidth

- accounting for bandwidth used in the p2p setting
- compensating nodes based on the bandwidth they provide

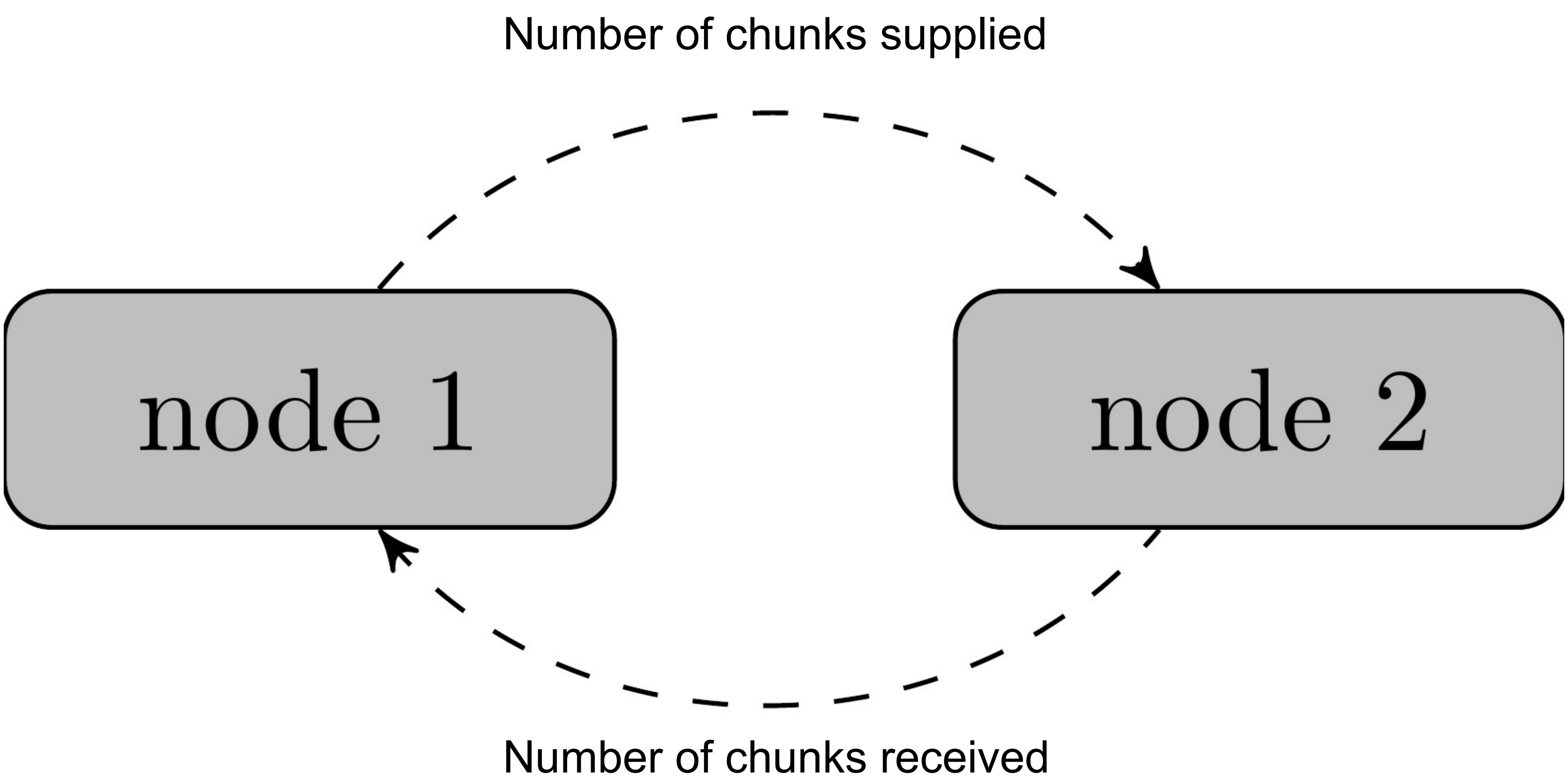
## Storage

- allow for long-term storage of data in the swarm
- provide proper compensation to nodes for storing data

# Swarm Incentive System

## Bandwidth

### Bandwidth accounting is per-peer



# SWAP – Swarm Accounting Protocol

# SWAP – Swarm Accounting Protocol

- Keeps track of number of chunks provided/received per peer
- Can trade chunk-for-chunk or chunk-for-payment
- Payments are made using the swarm chequebook contract on the blockchain

    (cheques are cumulative: you only ever have to cash the last one, thus saving transaction costs)

# SWAP – Swarm Accounting Protocol

Big picture:

- If you download a lot of content, you pay your peers for providing it.
- If you host popular content, you will earn fees from your peers for making the content available.
- Swarm is auto-scaling.

  -interplay of routing protocol and per-chunk payment between peers means that popular content will be widely distributed thereby increasing available bandwidth while decreasing latency

# Swarm Incentive System

## Storage

The Problem:

I want to deploy my content only once:
“upload and disappear”.

I want to make sure the content remains available years into the future even if it is not popular content.

Solution:

Pay certain nodes to keep your data.

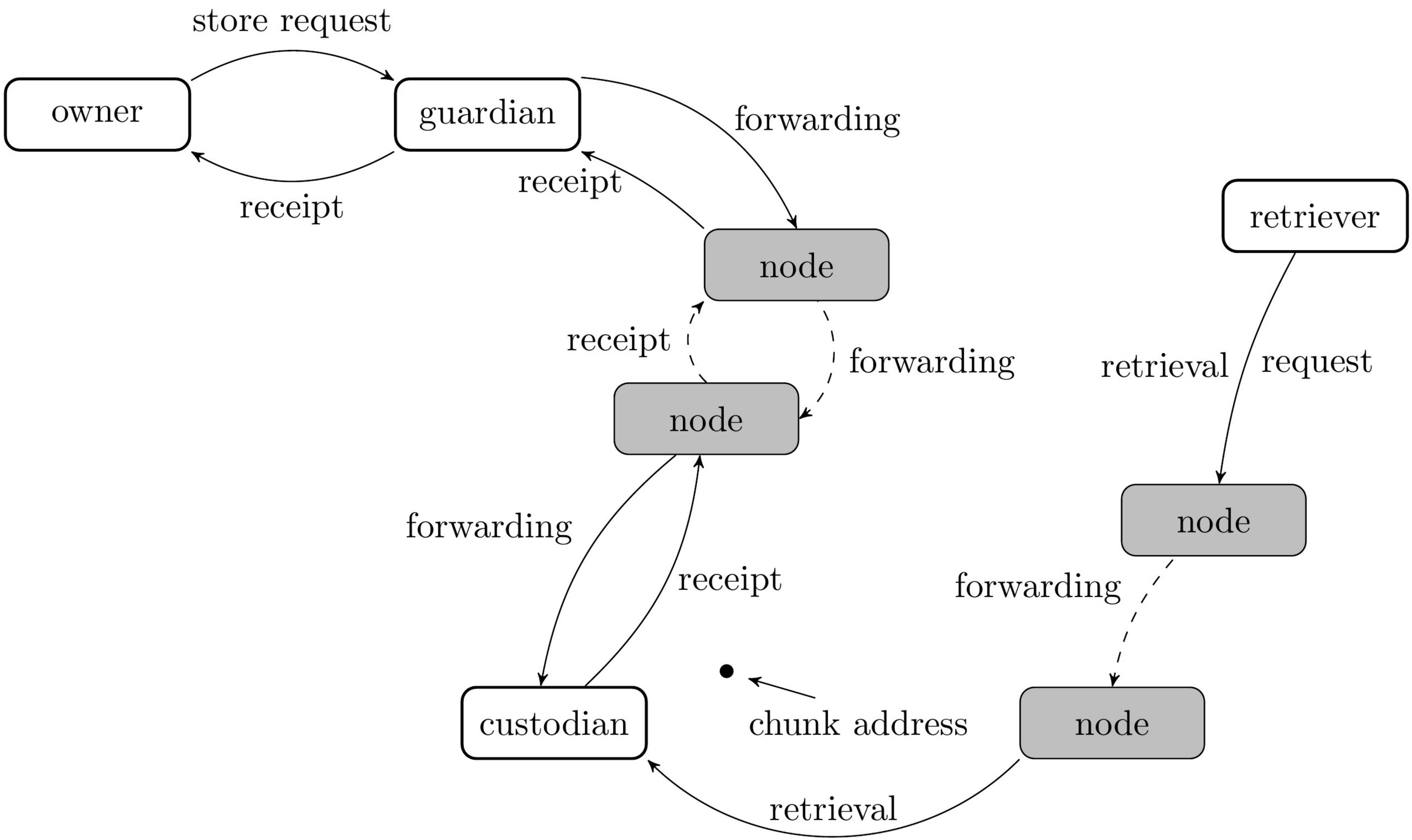
-Nodes that sell such promises-to-store must have a deposit locked on the blockchain.
-Nodes that loose content, loose their deposit.

# Swear and Swindle

# SWEAR

- Nodes register with the SWEAR contract and pay a deposit.
- Registered nodes can sell receipts for chunks received.
- Receipts are promises that the data remains available in the swarm.
- “Upload and Disappear” made possible by the system of ‘guardians’

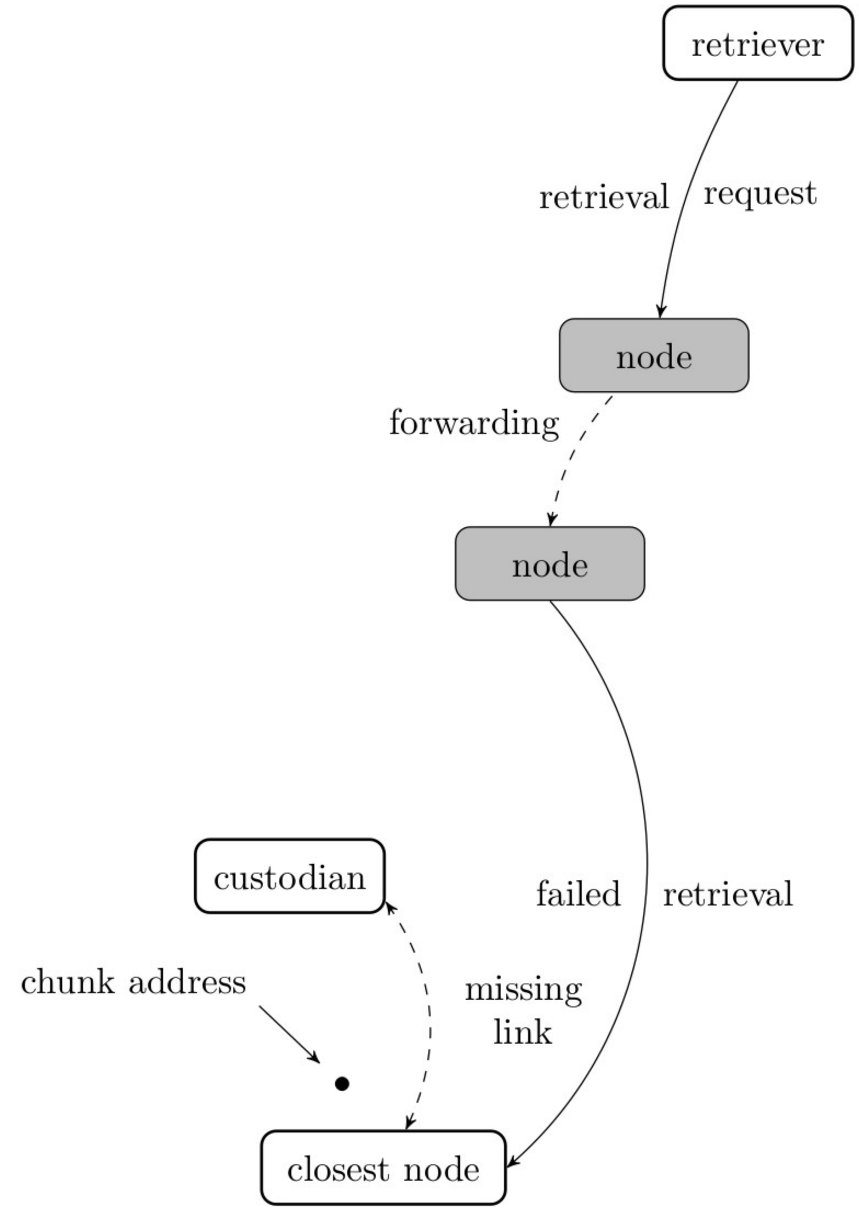
# Storing content in the swarm:



# What if the data cannot be found?

# Example:

Chunk is not actually ‘lost’ -
It is still in the swarm,
but lookup fails because
chunk never reached
the closest node.

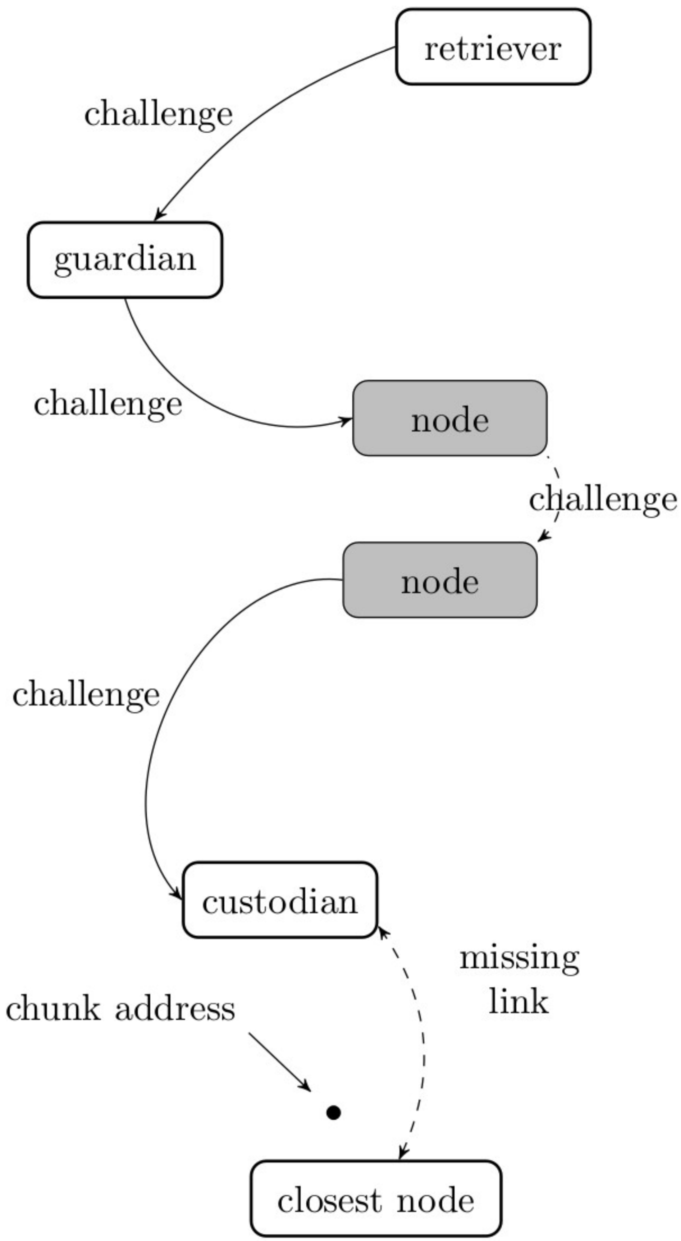


# SWINDLE

# SWINDLE – Secured with Insurance Deposit Litigation and Escrow

# SWINDLE

- Issue ‘challenges’ to the guardian to show proof-of-custody of the chunk shown in the receipt.
- Guardian can defend themselves by showing proof-of-custody or guardian will forward a challenge to the next node.
- Chain of receipts ends up with either
  1) A node storing the chunk (custodian)
  2) A node that should have the chunk but lost it.




- Retriever challenges guardian
- Guardian challenges the node that it bought a receipt from.
- Nodes forward challenges until the custodian is found.

# Results of Litigation

1) The Custodian is found; the missing link is identified; the swarm is repaired
2) The Chunk is indeed lost and the offending node is punished (loss of deposit)

# Dealing with Data Loss

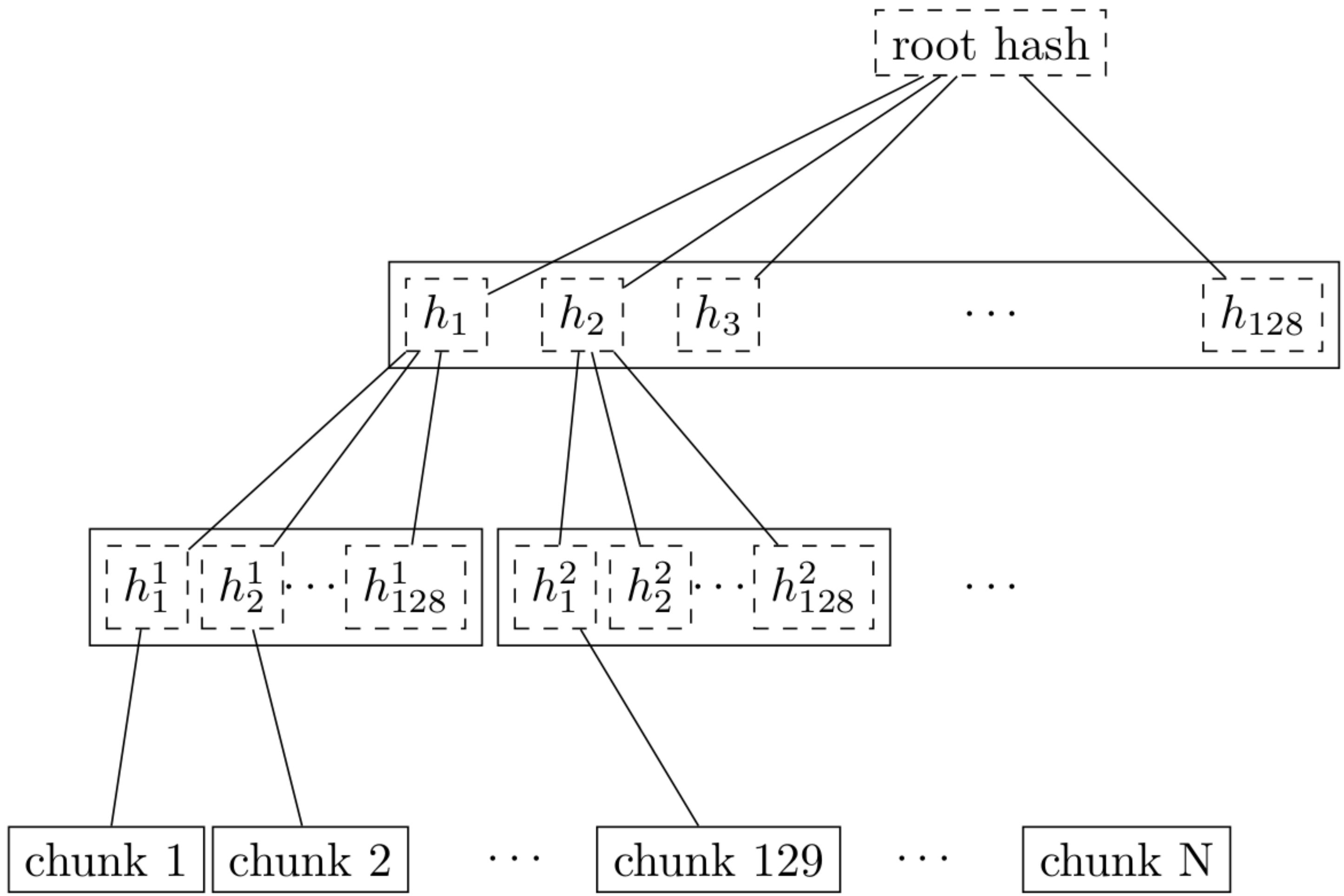
# Preparing your data with Erasure Codes

**Idea:** When preparing your file for the swarm – i.e. when generating the swarm chunk merkle tree – generate extra ‘redundancy chunks’ so that all data can be recovered even if individual chunks are lost.

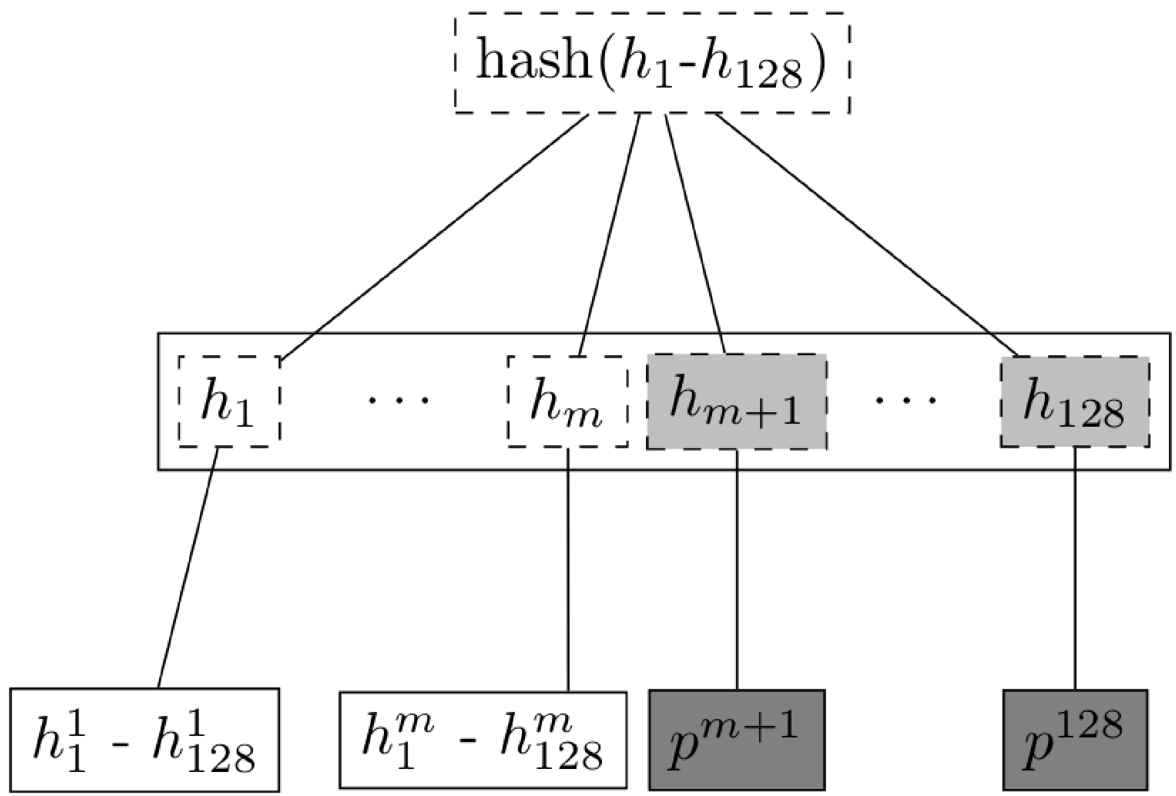
Benefits:

- Owner can set their own redundancy parameters
- Swarm can repair itself following data loss

# Ordinary Swarm Chunk Merkle Tree



# Adding Parity Chunks via Erasure Coding



Potential Benefits:

- All chunks in the tree are equally important for retrieval.
- **Any** node can repair swarm if data loss is discovered.
- Requesting **all** chunks (data + parity) can greatly reduce latency. This could lead to more responsive dapps.

- But Erasure coding is not enough, especially for large data sets you have to be able to monitor and repair.
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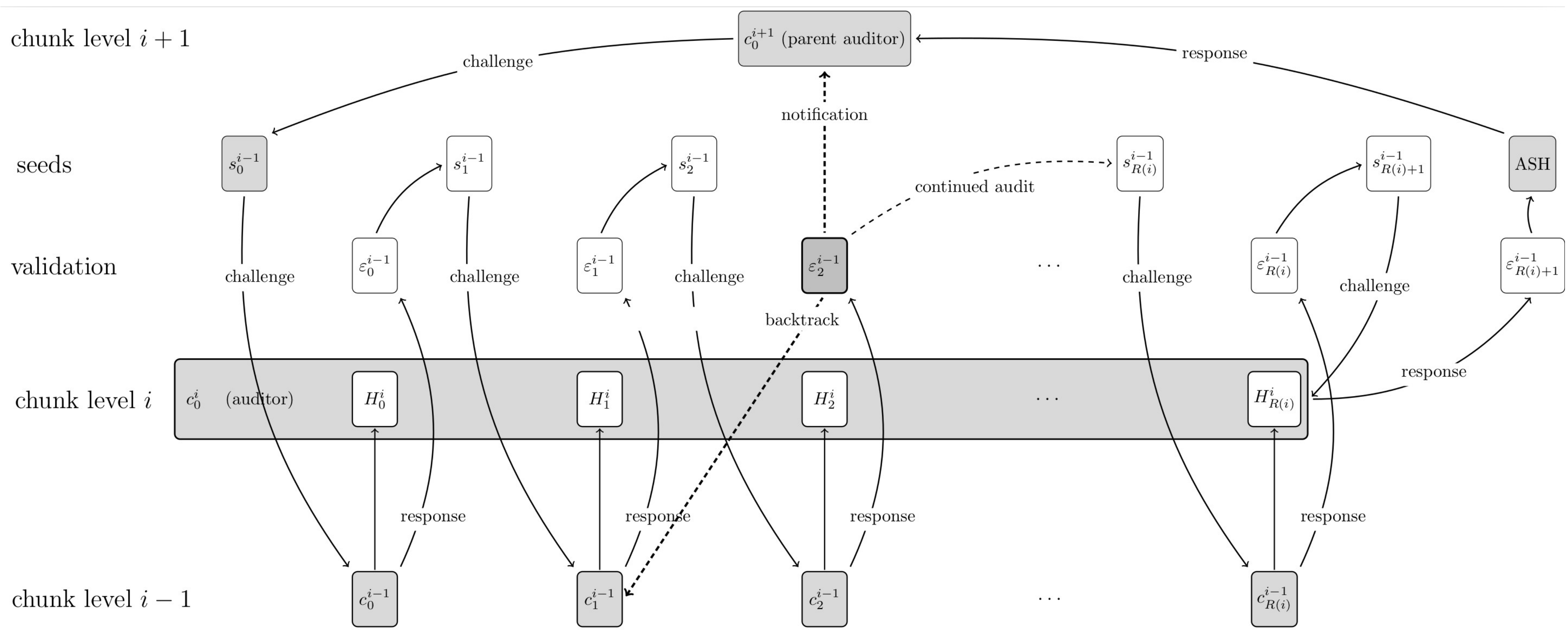

- But Erasure coding is not enough, especially for large data sets you have to be able to monitor and repair.

- Swarm includes an audit system able to identify missing chunks.

- The same auditing system is used as a condition to periodically release payments for long-term storage agreements.

  Idea: “each new payment requires a proof (audit) that the data is really still available”

SWAP • SWEAR • SWINDLE

# The Web3 Experience

# swarm: Basic architecture

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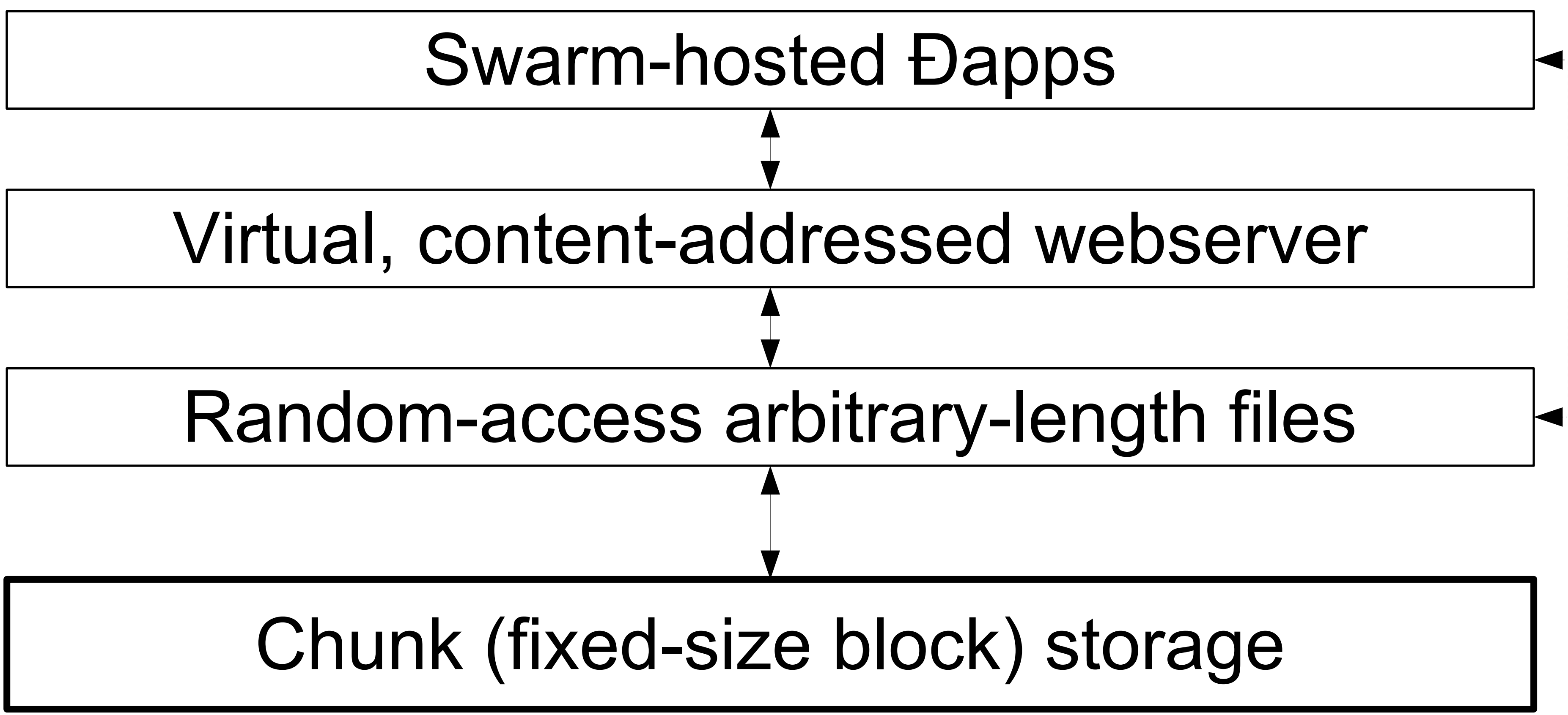

# swarm: Web3 user experience

- Familiar: hypertext with multimedia in a browser
  - Interactive, responsive, intuitive
- Personalization and identity management
  - Selectable personae, identities
  - Part of browser, not application
- Legal and financial interactions
  - Binding agreements
  - Payment with provable receipts
  - Rate-limits, confirmations with passwords, etc.

# Swarm: Đapp mechanics

- Current root hash registered on block chain
- Most static and dynamic data in Swarm
- Global state changes on block chain
- Local state changes stored locally
  - Optionally backed up in swarm and/or block chain
- Business logic gets executed locally
  - But verified globally by means of Ethereum

# Web3 experience

# What’s next? (Roadmap)