Introduction to IPFS

Web Verifiability through Content Addressing

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SHIPYARD

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Why verifiability matters

- Trust & Transparency
- Security & Accountability
- DApps Resilience

- Recent example: ByBit hack

Could IPFS have prevented the Bybit hack?

Agenda

1. What is IPFS?
2. Content Addressing
3. Content Routing
4. IPFS on the Web
5. Common Misconceptions

What is IPFS?

- IPFS = **I**nter**P**lanetary **F**ile**S**ystem
- Peer-to-peer hypermedia protocol for content addressing
- Aims to make the web faster, safer, and more open
- Does IPFS have a blockchain? No.
  - `https://doesipfshaveablockchain.com`

Location Addressing vs Content Addressing

Location Addressing	Content Addressing
Where is the data	*What is the data?*
Uniform Resource Locator (URL) `https://example.com/foo/bar.jpg`	Content Identifier (CID) `bafybeihfg3d7rdltd43u3tfvn...uc7y`
Server down? The data is unreachable	Anyone can serve the same data
Limited verifiability — trust the server to provide correct data	Full verifiability — if content changes, CID changes
Censor-prone — block IP or domain name	Hard to censor — all providers must be blocked

Content Identifiers (CIDs)

- Immutable, self certifying name
- Made of hash and meta data

CIDV1 (BASE32)

bafybeihfg3d7rdltd43u3tfvncx7n5loqofbsobojcadtmokrljfthuc7y

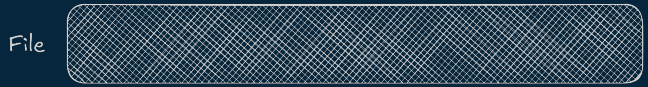
HUMAN READABLE CID

base32 - cidv1 - dag-pb - (sha2-256 : 256 : E536C7F88D731F374DCCB568AFF6F56E838A19382E488039B1CA8AD2599E82FE)

MULTIBASE - VERSION - MULTICODEC - MULTIHASH (NAME : SIZE : DIGEST IN HEX)

source: `cid.ipfs.tech`

Merkle DAG



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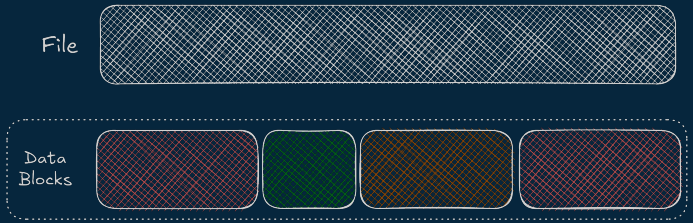

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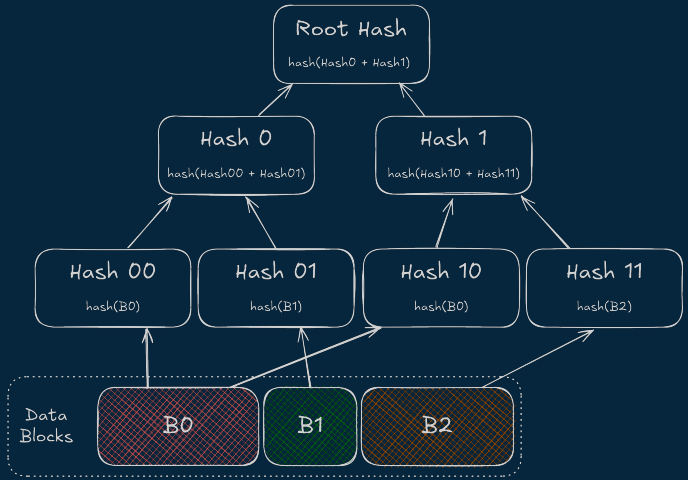
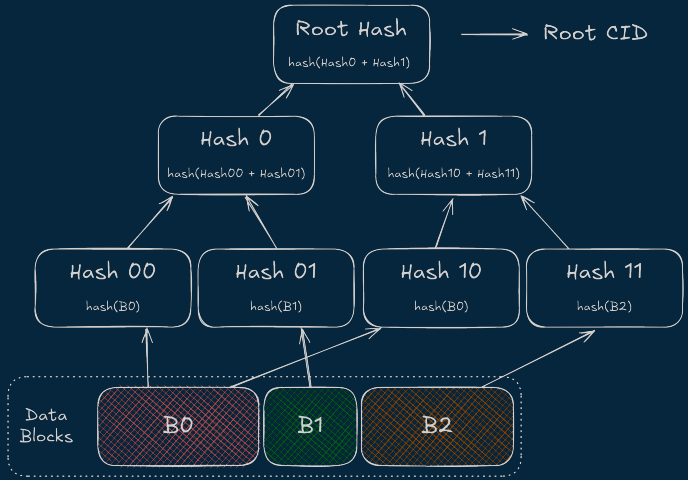

Root Hash
hash(Hash0 + Hash1)
Hash 0
hash(Hash00 + Hash01)
Hash 1
hash(Hash10 + Hash11)
Hash 00
hash(B0)
Hash 01
hash(B1)
Hash 10
hash(B0)
Hash 11
hash(B2)
Data Blocks
B0
B1
B2

Merkle DAG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hash(Hash0 + Hash1)
Root CID
Hash 0
hash(Hash00 + Hash01)
Hash 1
hash(Hash10 + Hash11)
Hash 00
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Hash 10
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Hash 11
hash(B2)
Data Blocks
B0
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B2

libp2p

- Open source peer-to-peer networking library
- Peer ID: unique peer identifier derived from public key (`12D3KooWN1Mr...`)
- Transports: `tcp`, `quic`, `wss`, `webrtc`, `webtransport`
- Encrypted by default
- Features: Holepunching, Relays, Kademlia DHT, Gossipsub, etc.
- Networking layer of IPFS, Ethereum, Polkadot, Filecoin, etc.

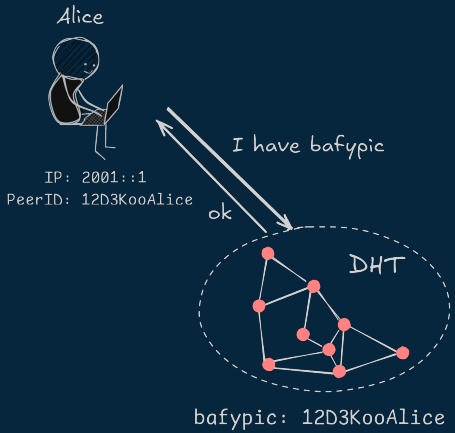
Content Routing

$ ipfs add

bafypic

IP: 2001::1
PeerID: 12D3KooAlice

Content Routing



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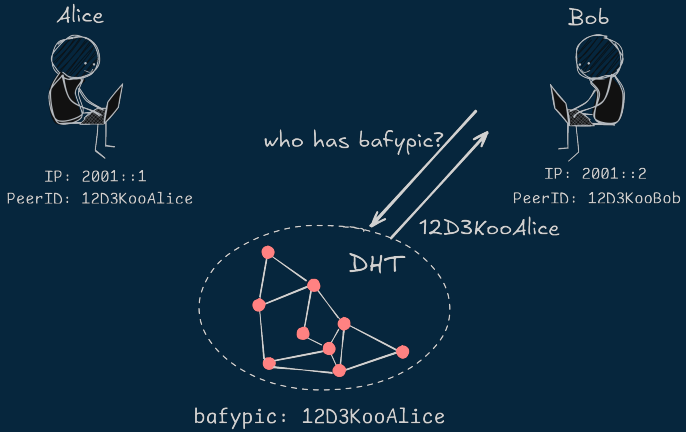

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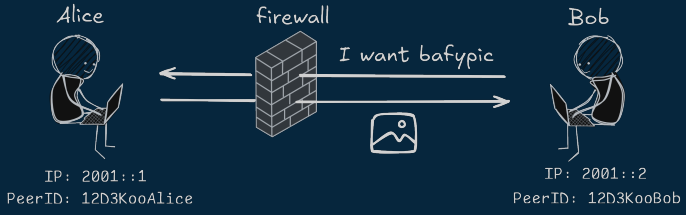

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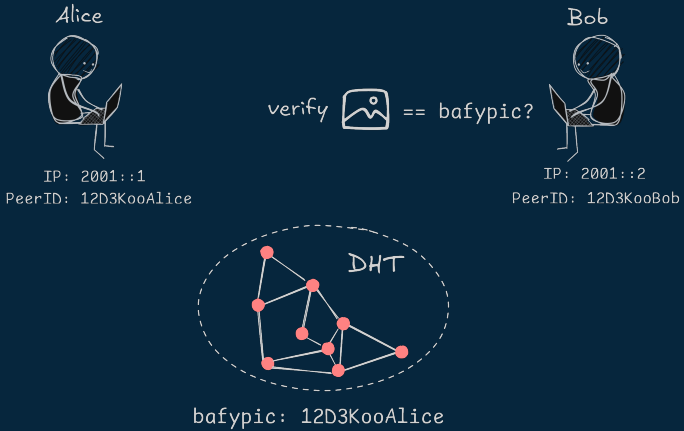

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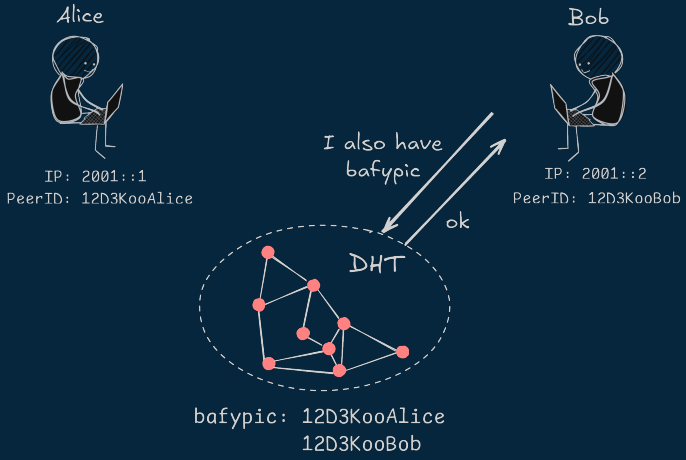

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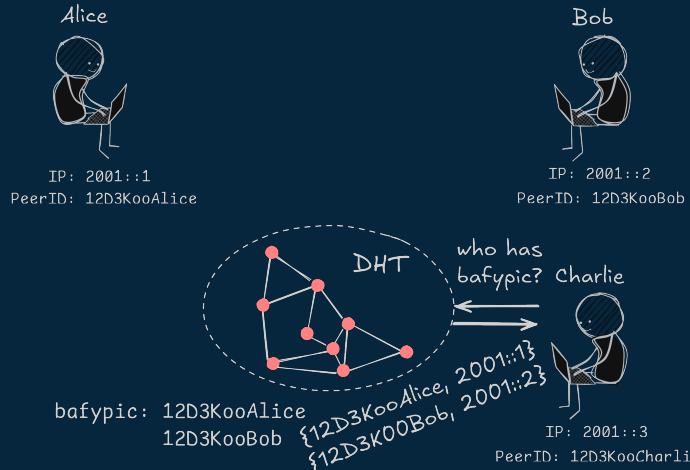

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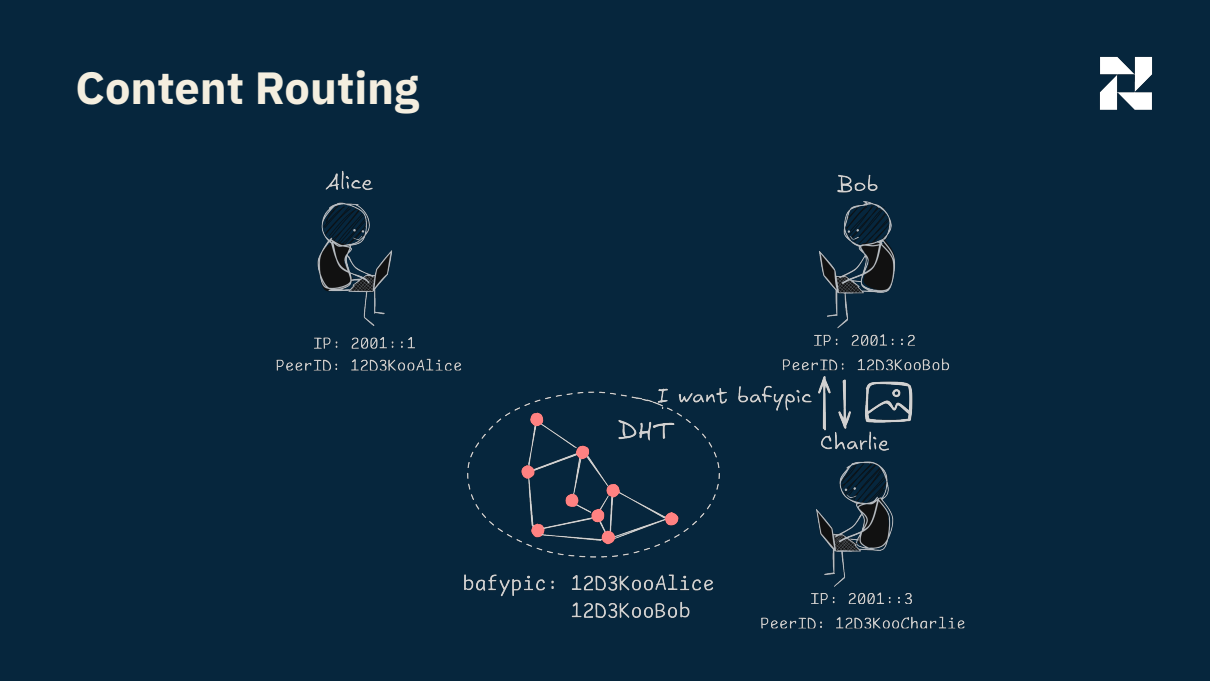

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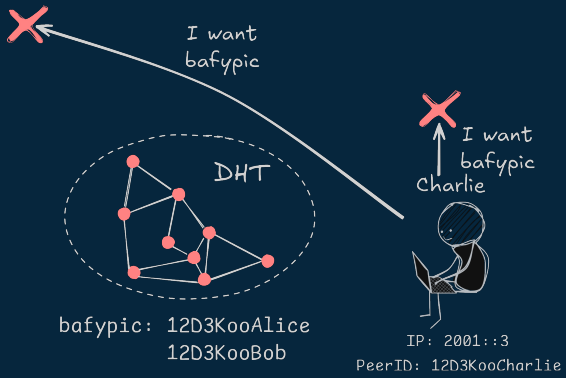

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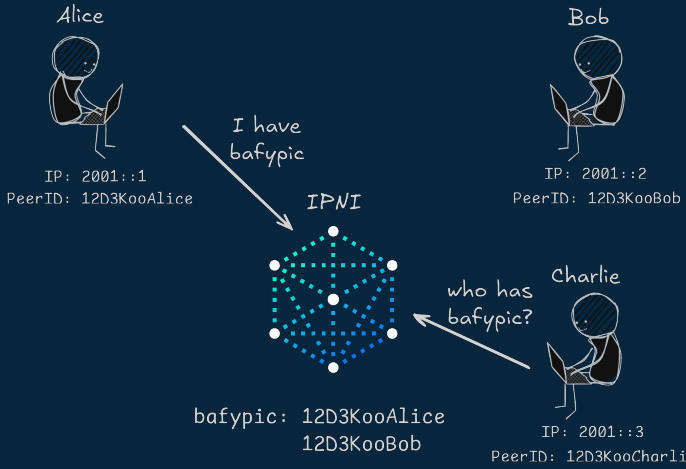
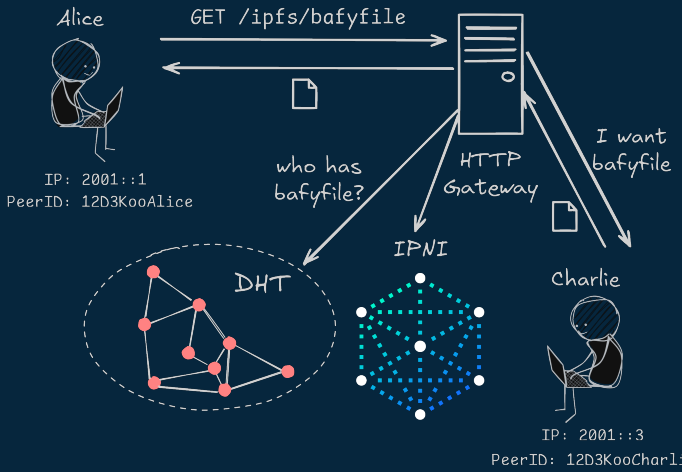


Bridging the Web: IPFS HTTP Gateways

- Browsers have limited connectivity:
  - `wss`
  - `webrtc`
  - `webtransport` (WIP)
- HTTP can be used for data retrieval!

Bridging the Web: IPFS HTTP Gateways

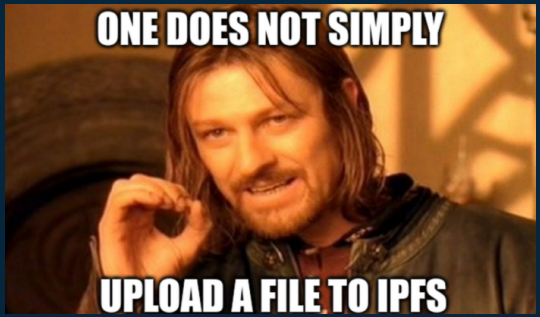


Bridging the Web: IPFS HTTP Gateways

- HTTP Gateways (ipfs.io, dweb.link)
  - `GET /ipfs/{cid}`
  - Gateway must be trusted
- Trustless gateways (`inbrowser.dev`)
  - Data verified in Service Worker
  - Uses Helia verified fetch
- Next Steps
  - Delegated Routing
  - Fetch from source

Common Misconceptions

1. Uploading files to IPFS
2. Permanent data storage
3. Data replication
4. IPFS fully replaces HTTP
5. Privacy



Shipyard

- Engineering collective stewarding IPFS & libp2p
  - We ❤️ Open Source
  - Graduated from Protocol Labs in 2024
- Championing IPFS & libp2p specs
- Developping & maintaining kubo, helia, go-libp2p, js-libp2p and associated tooling
- Operating IPFS Gateways (ipfs.io) and DHT Bootstrappers
- Open for collaborations and supporting your IPFS use cases
  - contact@ipshipyard.com

https://ipshipyard.com

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Q&A

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Slides available on IPFS