IPFS @ JÜLICH

AN UPDATE

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Mitglied der Helmholtz-Gemeinschaft

JÜLICH
Forschungszentrum

IPFS

IPFS is a client/server software that makes local files available for global download.

At its core, it is two things:

- a distributed database “DHT”, creating a peer-to-peer (P2P) network for localising files
- a distributed download protocol

Distributed, not federated.

Every file has a unique name, e.g.:

```
bafybeie35inljxm4vy3n5rihycqdkwjt5cr5erwxtlfsz2tcqsjc5iaacy
```

This name is its checksum!

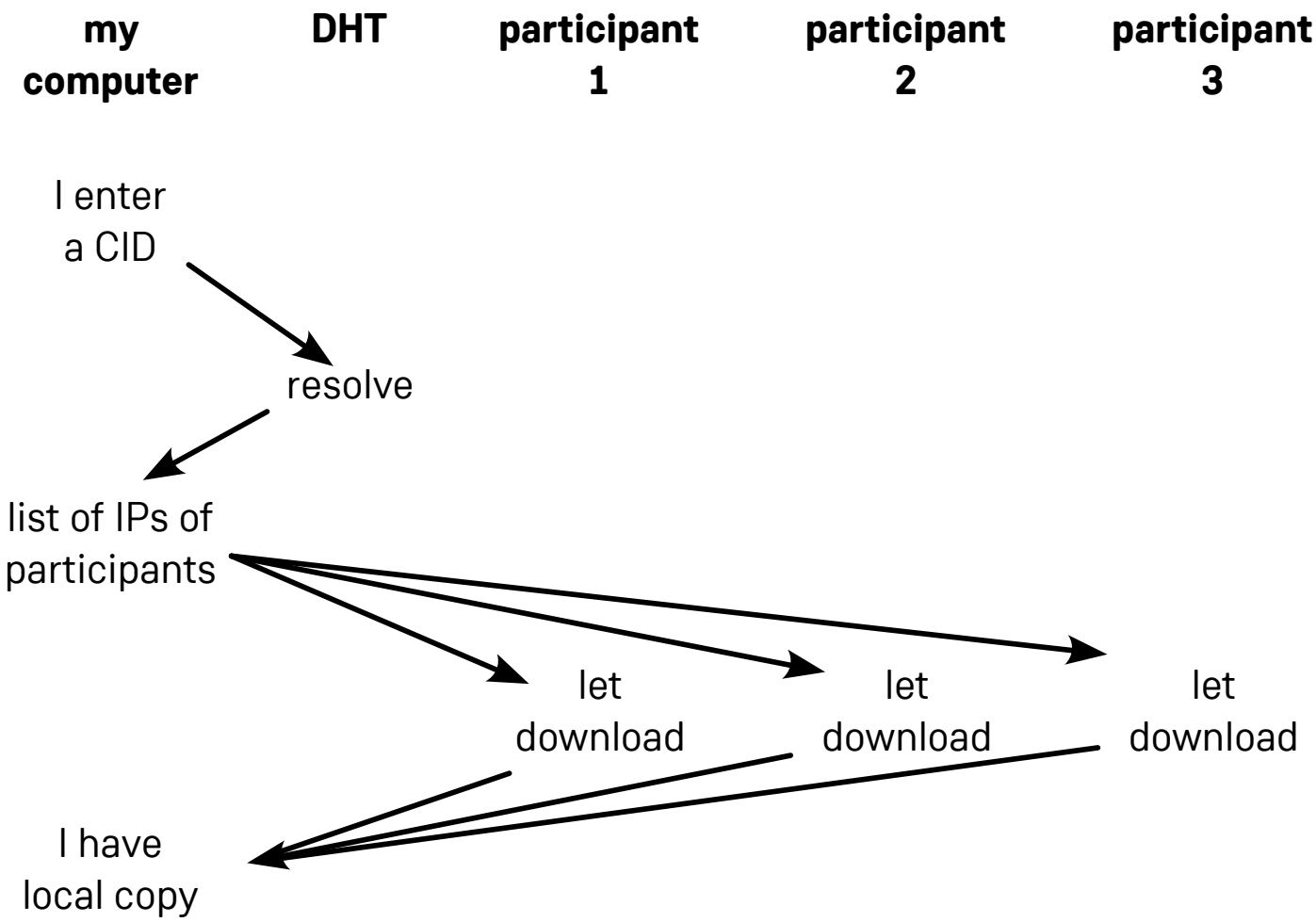
BENEFITS FOR RESEARCH DATA

- efficient transfers of *big* data
- data is only moved if needed at the destination
- really persistent IDs
- everything is published globally
- integrity checks not necessary
- direct support for knowledge graphs (IPLD)
- mutual mirroring of partner sites

Its distributed nature implies:

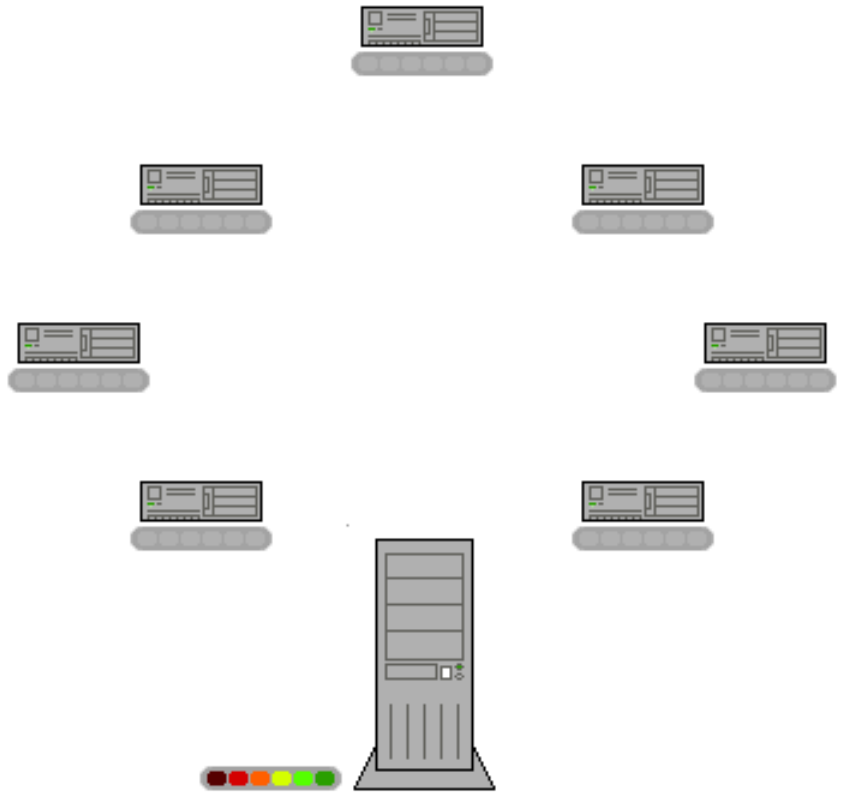
- no single point of failure
- no governance needed; nobody needs to trust each other

FLOW


my computer
DHT
participant 1
participant 2
participant 3
I enter a CID
resolve
list of IPs of participants
let download
let download
let download
I have local copy

BITTORRENT

Optimised global distribution of large files.



Source: Wikipedia

DEMO

IPFS Desktop app: https://docs.ipfs.tech/install/ipfs-desktop (https://docs.ipfs.tech/install/ipfs-desktop)

Extensive command line tools are also available.

And, you can use libraries to integrate IPFS into your own programs.

MUTABILITY

IPFS names are checksums – everything in IPFS is immutable. So what if you need to update your files?

DNSLink

Part of the DNS record of "`fz-juelich.de`":

```
fz-juelich.de  A    134.94.130.222
fz-juelich.de  MX   mailgw-k01.its.kfa-juelich.de.
fz-juelich.de  MX   mailgw-e01.its.kfa-juelich.de.
fz-juelich.de  TXT  "v=spf1 ip4:134.94.4.32/27 ip4:134.94.130.39 mx ~all"
fz-juelich.de  TXT  "smartsheet-site-validation=meBaMf8aJI9vkU3a2bG-s4dJlElOz75Z"
```

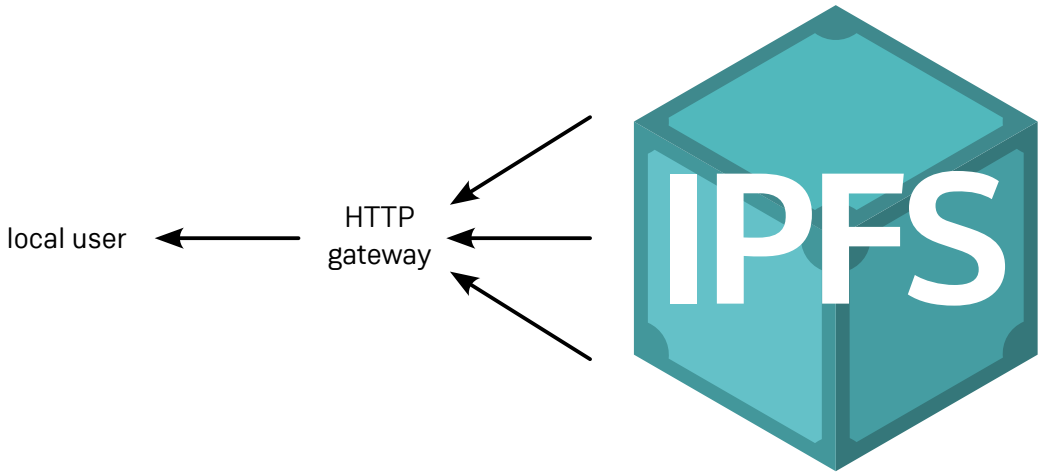
With DNSLink, you append a CID to the DNS record of e.g. Jülich DATA, pointing to the root of the current versions of all data stored in it:

```
data.fz-juelich.de  TXT  "dnslink=/ipfs/bafybeiay…phwekaywqhcjze"
```

HTTP GATEWAYS

A fallback if direct content to IPFS is not feasible, e.g.

```
https://ipfs.fz-juelich.de/ipfs/{CID}/sub/path
```

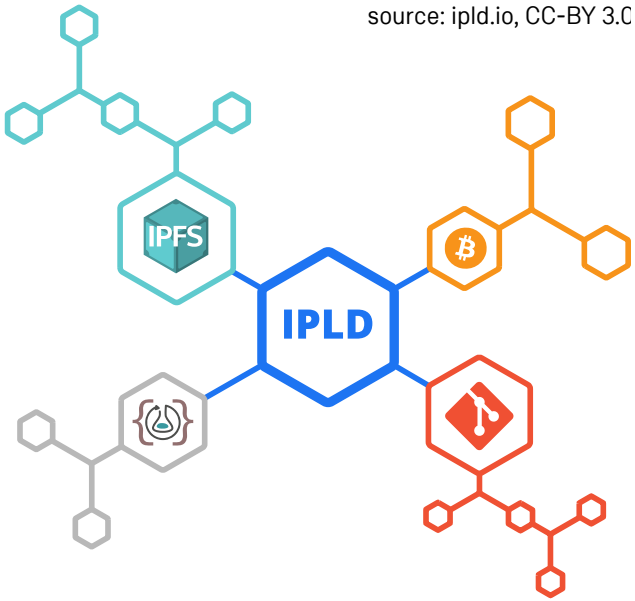


- would be limited to FZJ-hosted data
- one must trust the gateway if used through the browser

IPLD

One big namespace for all data. It has one root, from which you can traverse like through a directory hierarchy. The “directories” can be:

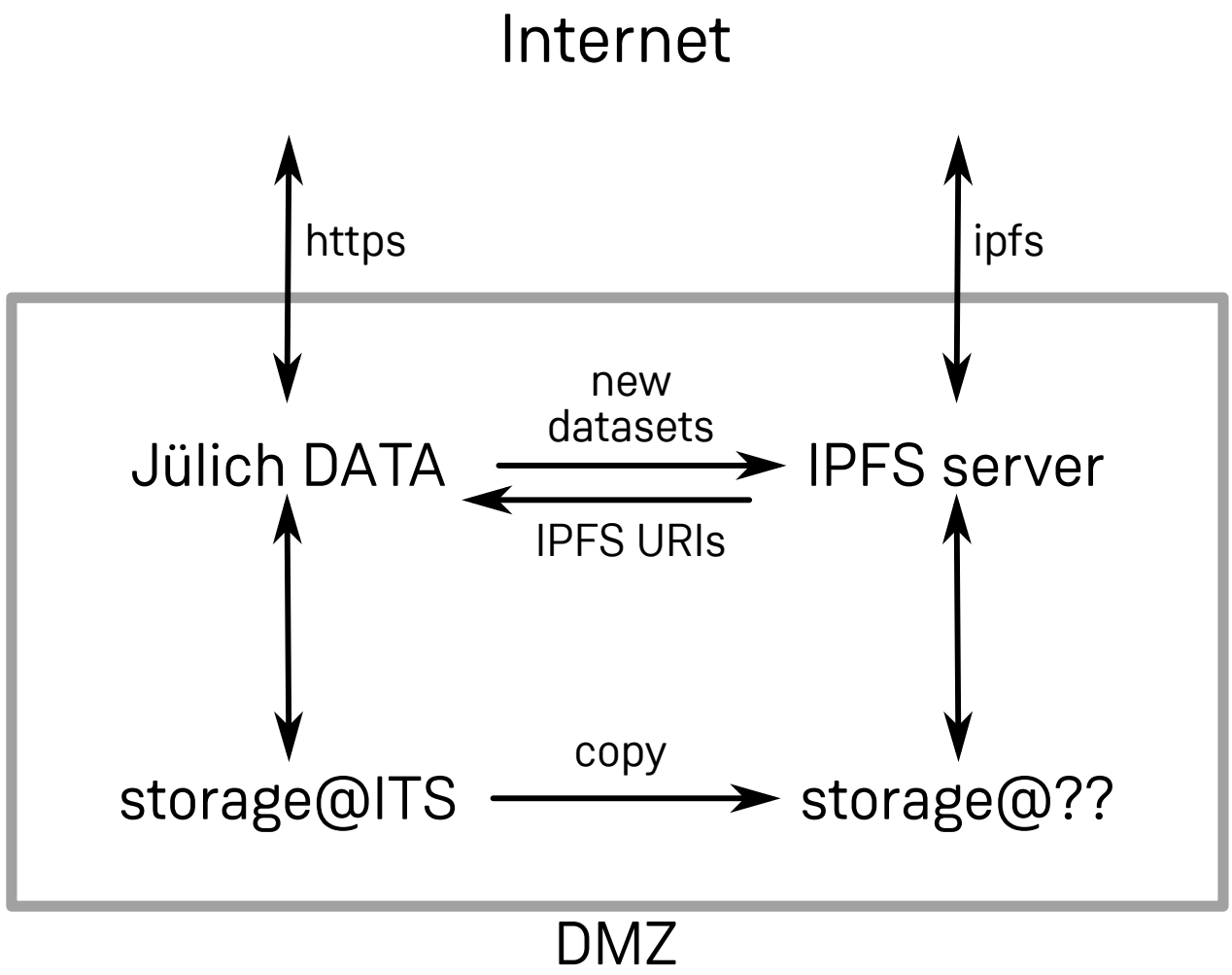
- file folders
- ZIP files
- Git repos (including all branches/commits)
- electronic lab notebooks (ELN) content
- …



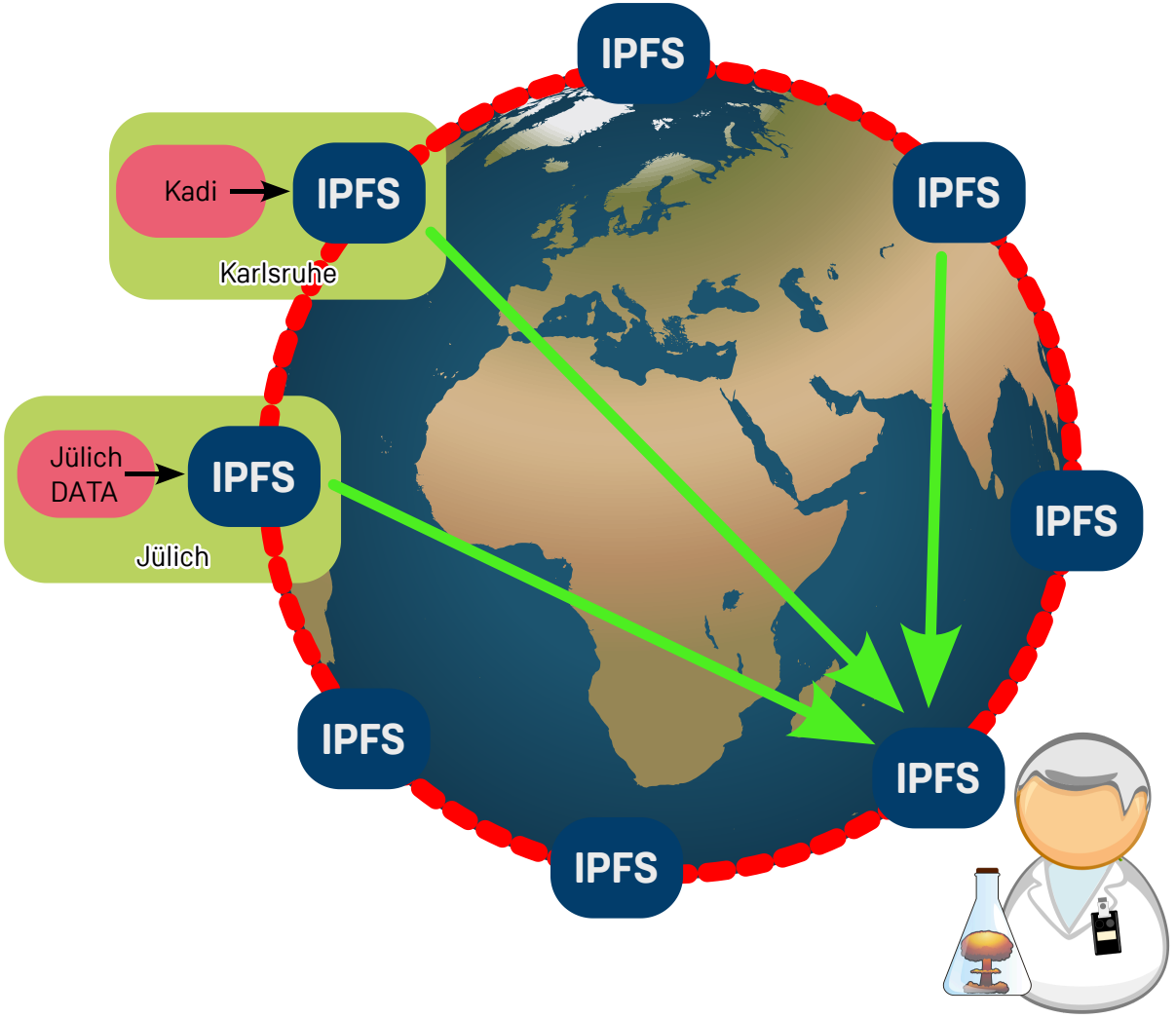
Traverse through data using different protocols, e.g.:

```
/ipfs/data.fz-juelich.de/IMD-19/ELN/samples/ER-32/heating-1/temperature
/ipfs/data.fz-juelich.de/IMD-19/pubs/2026/maier-nature-1/raws/curve1.csv
```

POSSIBLE REALISATION @ JÜLICH



IN NFDI4ING


IPFS
IPFS
Kadi
IPFS
Karlsruhe
IPFS
Jülich
DATA
IPFS
Jülich
IPFS
IPFS
IPFS

IN NFDI4ING

Partner institutions in NFDI4Ing will:

1. expose their published research data through IPFS
2. use remote pinning to advertise all new local data to partners (“remote pinning”)
3. ⇒ all partners mirror all data of all partners

Benefits:

- enable parallel downloading
- keep all data available, even if partners are temporarily unavailable
- keep all data available, even if partners leave IPFS for good

Proof of concept, next step would be: Find partners outside Deutsches Forschungsnetz.

THE FARTHER FUTURE

Remote pinning of FZJ researchers against Jülich DATA

- Jülich researchers make Jülich DATA to pin their data
- Jülich DATA extracts metadata automatically
- No direct interaction with a repo necessary anymore

CoD – Compute on Data

This is future tech realised by external projects: https://github.com/ipvm-wg (IPVM), https://bacalhau.org/ (Bacalhau)

Integration of Jülich ELNs in IPLD

- Write code to have RO-Crate living in IPLD
- Make RO-Crate exposable in elabFTW, SampleDB, JuliaBase, etc.

THANK YOU

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