WIFI: IPFS Cluster workshop

IPFS Cluster

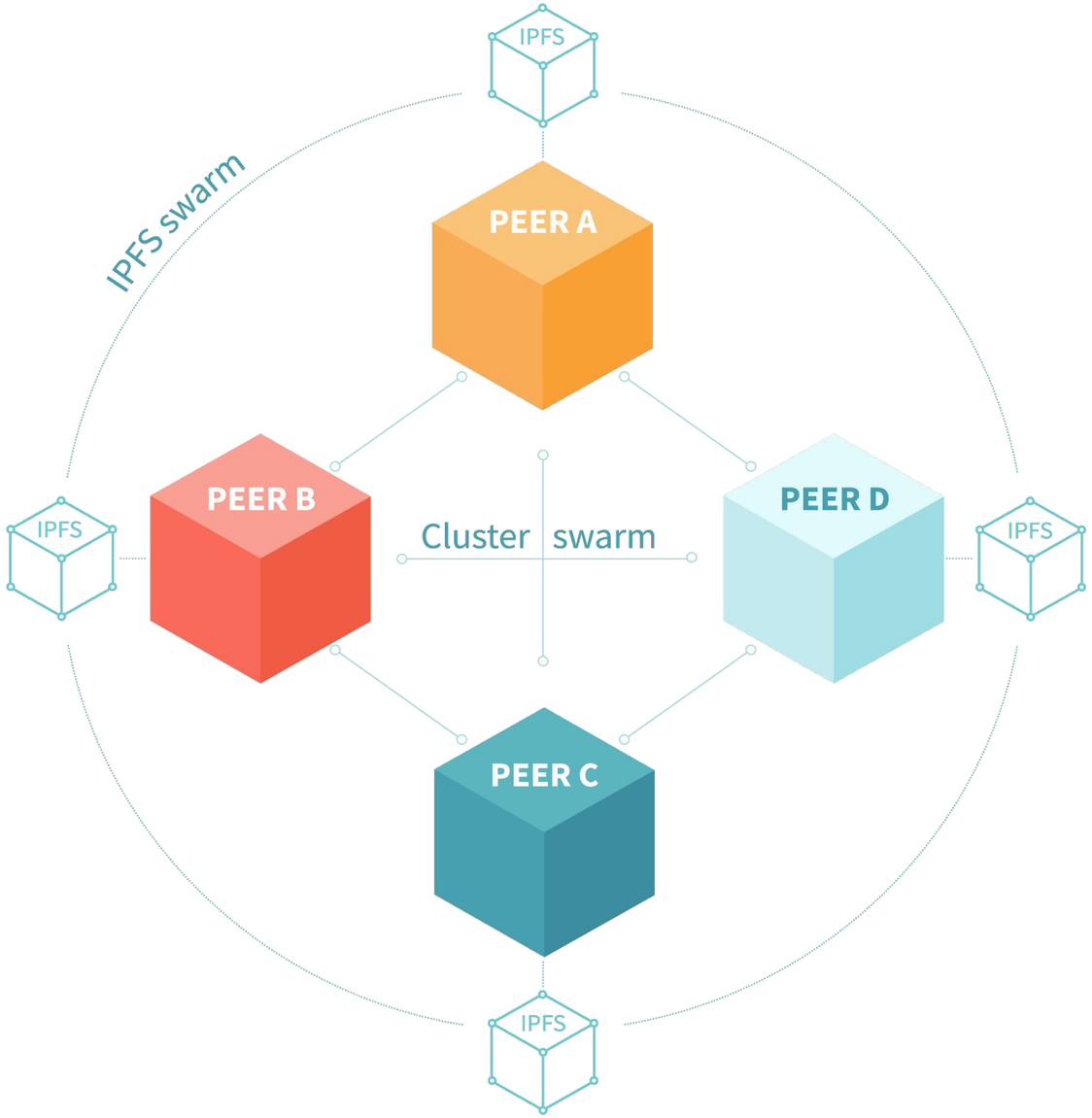
The Workshop

Web3 Conference 2019

Welcome!

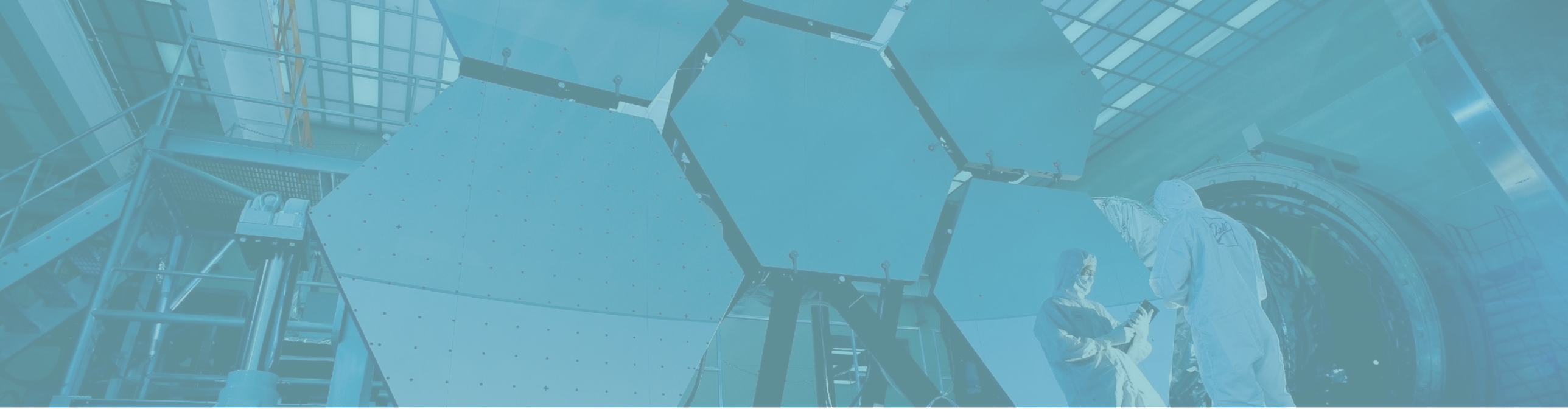
IPFS Cluster

- Manage a global pinset across multiple IPFS daemons
- Track the status of every pin on every peer
- Setup flexible collaborative Clusters to replicate content



Agenda

- 1. Installation
- 2. Hands-on
- 3. Cluster administration:
  - … using Raft
  - … using Crdt
- 4. Cluster usage
- 5. Cluster APIs and Integrations



Installation

Installation

1. Go to: https://github.com/ipfs-cluster/workshops/
2. Scroll to the workshops table. Find this workshop and click for instructions.

Hands on IPFS Cluster

Start your cluster peer

```
$ ./ipfs-cluster-service daemon
```

ipfs-cluster-ctl

```
$ ./ipfs-cluster-ctl --help daemon
$ ./ipfs-cluster-ctl [--enc=json] id
$ ./ipfs-cluster-ctl peers ls
$ ./ipfs-cluster-ctl pin ls
$ ./ipfs-cluster-ctl status
$ ./ipfs-cluster-ctl status --filter pinning
$ ./ipfs-cluster-ctl status $cid [--local]
$ ./ipfs-cluster-ctl health metrics freespace
$ ./ipfs-cluster-ctl pin add <hash>
$ ./ipfs-cluster-ctl pin rm <hash>
$ ./ipfs-cluster-ctl add somefile.txt
```

Cluster administration

ipfs-cluster-service init --consensus <crdt|raft>

- Creates:
  - `~/.ipfs-cluster/service.json`: the main config. Should usually be the SAME in every peer.
  - `~/.ipfs-cluster/identity.json`: peer ID and private key. Should be different in every peer.

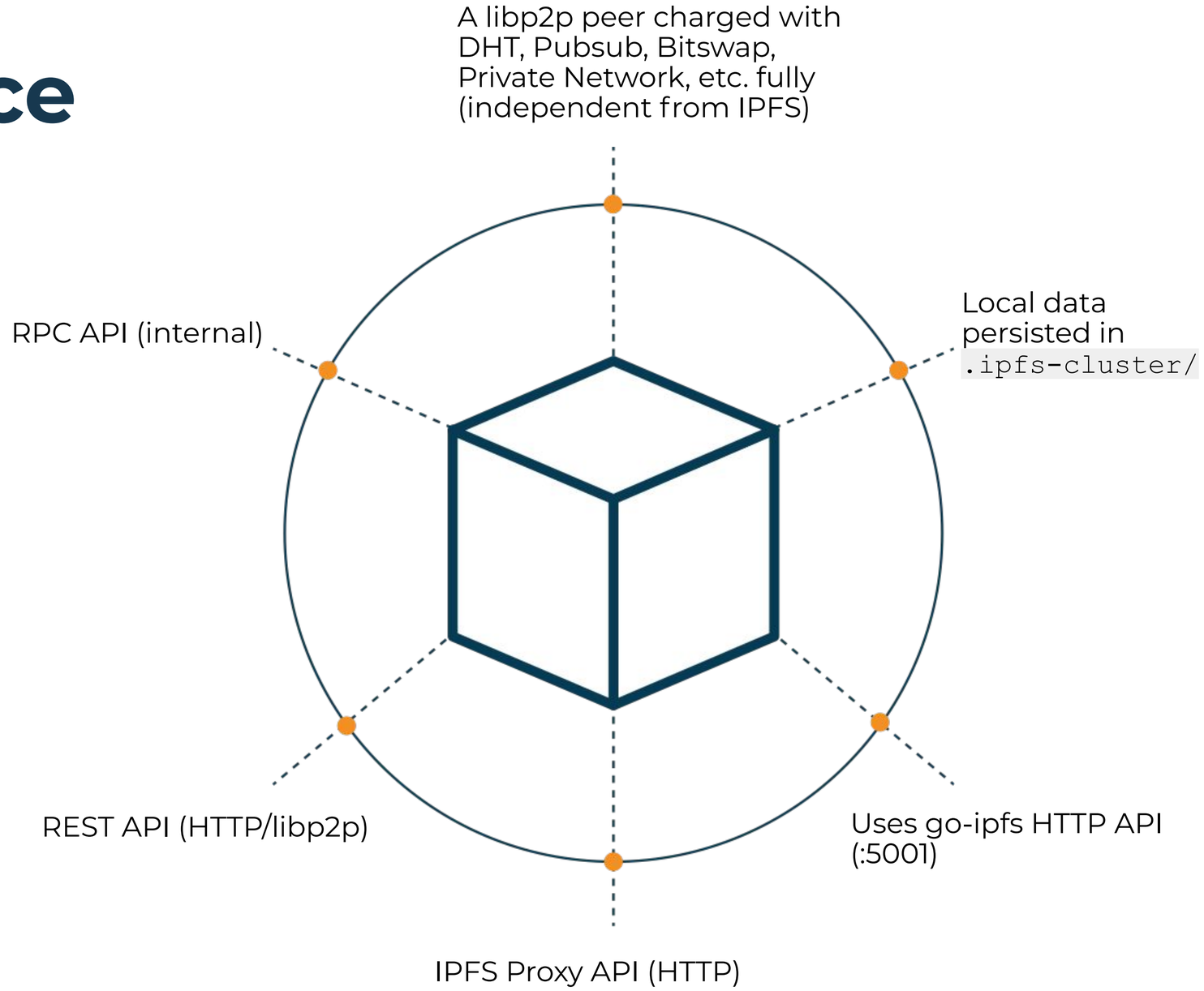
The Cluster Peer:

ipfs-cluster-service

- ipfs-cluster-service **init**
  --consensus {crdt|raft}

- ipfs-cluster-service **daemon**

- ipfs-cluster-service **state**
  - **export**
  - **import**
  - **cleanup**



The configuration file

```
{
  "cluster": {
    "secret": "THE SAME SECRET FOR EVERYONE",
    <other options>...
  },
  "component_type": {
    "component_implementation": {
       <options>
    }
  }
}
```

- Multiple APIs used. Only one pin_tracker, consensus, informer...
- Some implementation choices can be selected with flags to `ipfs-cluster daemon`

```
{
  "cluster": {...},
  "consensus": {
    "crdt": {...}
  },
  "api": {
    "ipfsproxy": {...},
    "restapi": {...}
  },
  "ipfs_connector": {
    "ipfshttp": {...}
  },
  "pin_tracker": {
    "maptracker": {...},
    "stateless": {...}
  },
  "monitor": {
    "pubsubmon": {...}
  },
  "informer": {
    "disk": {...}
  },
  "observations": {
    "metrics": {...},
    "tracing": {...}
  }
}
```

The configuration file (standard)

```
{
  "cluster": {
    "secret": "THE SAME SECRET FOR EVERYONE",
    <other options>...
  },
  "component_type": {
    "component_implementation": {
       <options>
    }
  }
}
```

The configuration (remote source)

```
{
  "source": "http://url..."
}

# Protip: Use IPFS to distribute configs and
# set to http://127.0.0.1:8080/ipfs/Qm...
```

Running a Raft Cluster

- **Peer** additions and removals require a raft commit
- **Pin** additions and removals require a raft commit
- Raft commits requires quorum and are redirected to raft leader which executes them (slow pin ingest)
- Must trust all peers! (every peer can do everything)
- Suitable for stable clusters, long-lived peers. Raft is very mature (same Raft implementation as Consul)

Running a CRDT Cluster

- Peers can join and leave freely
- “`trusted_peers`”: only operations submitted by trusted peers are applied
- Pubsub to distribute the new heads of an always growing DAG
- Experimental, super flexible, fast ingestion
- Suited for collaborative clusters (untrusted peers cannot affect your peer). “Trusted peers” vs “followers”

Starting and Bootstrapping

- IPFS runs public bootstrappers for the IPFS Network
- Each cluster is its own Cluster swarm, therefore at least one of the cluster peers needs to act as “bootstrapper” for others
- Bootstrap is necessary on the first run of a cluster peer
- CRDT: Bootstrap not necessary if mDNS works to discover other local peers.
- Subsequent runs remember “peers” in the cluster

Bootstrapping (Raft)

- Any new peer **must** start with:
  `ipfs-cluster-service daemon --bootstrap <existing peer>`
- “Hello <existing peer>, please add me to the Raft peerset”.
- Subsequent starts should just use `ipfs-cluster-service daemon`
- The **`peerstore`** file with the raft peers addresses is automatically saved and the peer IDs in the cluster are part of the Raft internal state, also persisted. The **`peerstore`** can be however pre-filled by the user with known peer addresses.

Bootstrapping (CRDT)

- You can either start with:
  `ipfs-cluster-service daemon --bootstrap <existing peer>`
- or fill-in the `.ipfs-cluster/peerstore` file with some known peer multiaddresses
- or let mDNS discover peers on the LAN after starting
- When the peer is stopped known peer addresses will be added to the peerstore file for future usage
- Trusted peers are prioritized when bootstrapping

A healthy Cluster peer...

- Has a working ipfs daemon by its side
- Can connect to other peers in the Cluster:
  - Knows their Peer IDs and can learn their addresses via `peerstore` file or DHT query
- In Raft: knows a Raft leader or the cluster can elect one (>50% are online)
- In CRDT: receives pubsub updates from trusted peers (either by being connected to them or by having the relayed)

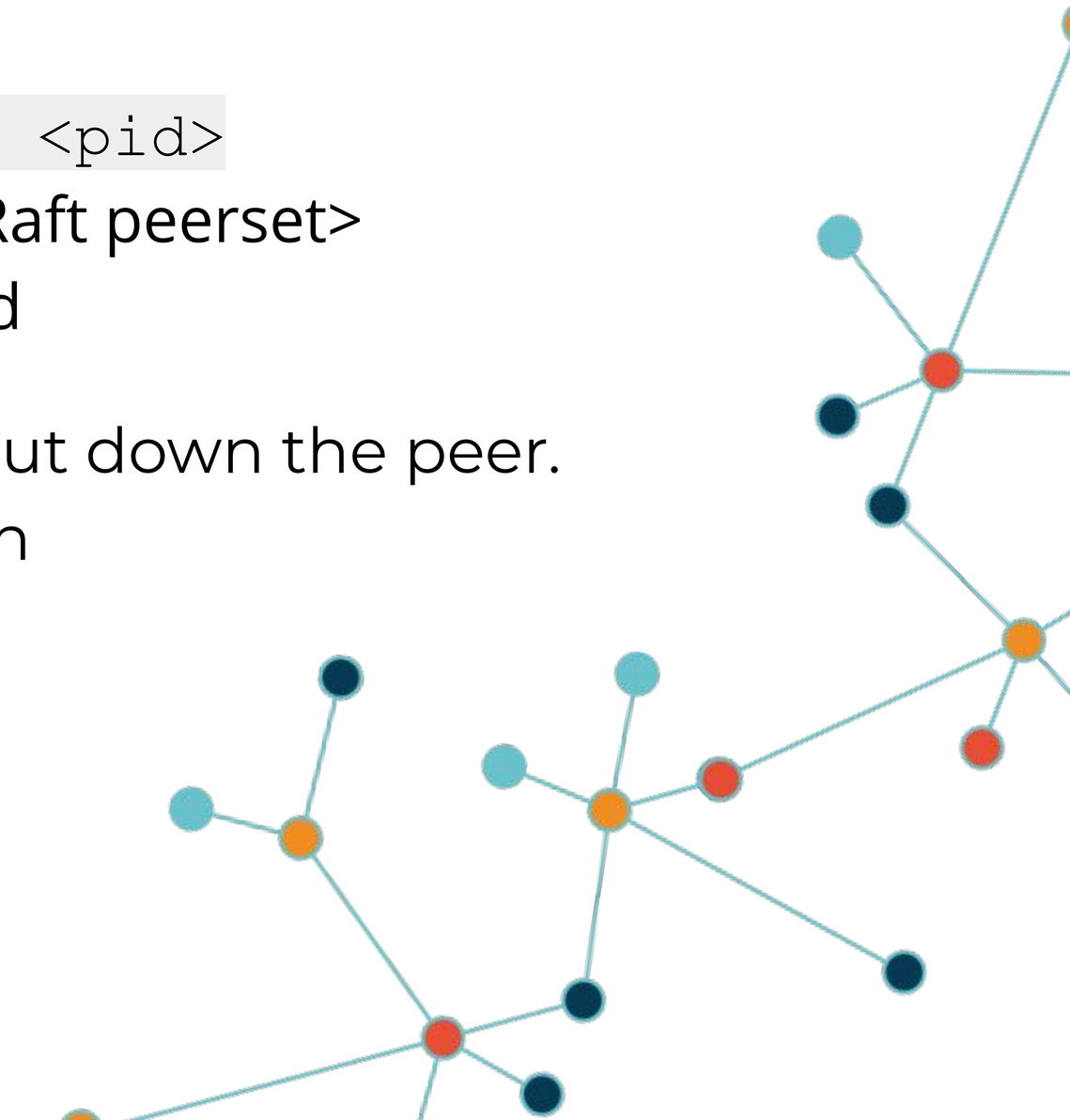
Adding more peers...

- Same as “bootstrapping”
- Re-using a peer for a different cluster:
  - In Raft: state is “cleaned” when bootstrapping (it will be synced from the Cluster)
  - In CRDTs: you probably want to run `ipfs-cluster-service state cleanup` when joining a “new” cluster.

Removing peers...

- In Raft: `ipfs-cluster-ctl peers rm <pid>`
  - <Please remove this Peer ID from the Raft peerset>
  - Peer needs to bootstrap to be re-added

- In CRDT: remove is a no-op. Simply shut down the peer.
  - Start the peer normally for it to rejoin



Disaster recovery

- Shutdown all peers and choose one
  - `ipfs-cluster-service state export -f state.json`
  - `ipfs-cluster-service state cleanup`
  - `ipfs-cluster-service state import state.json`
- Launch this single peer with the imported state.
- Cleanup and bootstrap the rest of peers to it.

Deployment automations

- Kubernetes:
  - With Kustomize
  - Most useful for AWS, GCP, Azure
- Ansible roles:
  - Most useful for regular cloud providers: Hetzner, Digital Ocean...
- Docker containers / compose
  - Manual setups and others
  - Quick testing

Cluster usage

ipfs-cluster-ctl

- `ipfs-cluster-ctl` is a CLI client to the HTTP REST API
- 99% feature-parity with the API
- `ipfs-cluster-ctl` **`id`**
- `ipfs-cluster-ctl` **`peers ls`**
- `ipfs-cluster-ctl` **`pin add`** `--rmin X --rmax Y --name abc...`
- `ipfs-cluster-ctl` **`add`** `--recursive --name abc myfile.txt`
- `ipfs-cluster-ctl` **`health graph`**
- `ipfs-cluster-ctl` **`health metrics`** `freespace`

ipfs-cluster-ctl pin ls [cid]

- Displays "allocations"
- aka the Cluster Pinset
- aka the global state

- Every peer keeps their copy of the global state which is the same everywhere.


```
{
  "replication_factor_min": 1,
  "replication_factor_max": 3,
  "name": "a name",
  "shard_size": 0,
  "user_allocations": null,
  "metadata": null,
  "cid": {
    "/": "QmT8n..."
  },
  "type": 2,
  "allocations": [<peerID1,
peerID2],
  "max_depth": -1,
  "reference": null
}
```

ipfs-cluster-ctl status [cid]

- Displays "pin status"
- aka the "local state"...
- ...by querying all peers for their pin statuses and merging them.

- A `status` query connects to all peers to retrieve the actual status of a pin in each of them.
- We call this a "broadcast" operation


```
{
 "cid": {
     "/": "QmcD..."
 },
 "peer_map": {
   "<peerID1>": {
     "cid": { "/": "QmcD..." },
     "peer": "<peerID1>",
       "peername": "cluster2",
       "status": "pinning",
       "timestamp": "2019-06-10...",
       "error": ""
     },
   "<peerID2>": {
      "cid": { "/": "QmcD..." },
      "peer":" <peerID2>",
      "peername": "cluster3",
      "status": "pinned",
      "timestamp": "2019-06-10T...",
      "error": ""
   }
  }
}
```

ipfs-cluster-ctl sync [cid]

- The "pin status" are cached for a few minutes.
- `ipfs-cluster-ctl sync` basically runs `ipfs pin ls` and updates the "pin state" to match that of ipfs if it has changed.
- Run regularly by cluster automatically.


```
{
  "cid": {
      "/": "QmcD..."
  },
  "peer_map": {
    "<peerID1>": {
      "cid": { "/": "QmcD..." },
      "peer": "<peerID1>",
       "peername": "cluster2",
       "status": "pinning",
       "timestamp": "2019-06-10...",
       "error": ""
     },
     "<peerID2>": {
       "cid": {  "/": "QmcD..." },
       "peer":" <peerID2>",
       "peername": "cluster3",
       "status": "pinned",
       "timestamp": "2019-06-10T...",
       "error": ""
    }
  }
}
```

ipfs-cluster-ctl recover [cid]

- `ipfs-cluster-ctl recover` attempts to fix pins in "pin error" or "unpin error" status.

- Re-triggers the operation on IPFS

```
{
  "cid": {
      "/": "QmcD..."
  },
  "peer_map": {
    "<peerID1>": {
      "cid": { "/": "QmcD..." },
      "peer": "<peerID1>",
        "peername": "cluster2",
        "status": "pin_error",
        "timestamp": "2019-06-10...",
        "error": "Connection refused"
      }
   }
}
```

APIs and integrations

REST API

- Used by `ipfs-cluster-ctl`
- Runs on port :9094 by default
- Also runs as a libp2p-service (either as part of the cluster host or with an additional one)
  - Free encrypted channel!
- Supports custom CORS, HTTPs and Basic Authentication (out-of-the-box)

IPFS Proxy API

- Runs on port :9095 by default
- Behaves like IPFS. Forwards all requests to IPFS daemon except:
  - `/api/v0/pin/add`, `/api/v0/pin/rm`: trigger cluster pin/unpin with default options
  - `/api/v0/pin/ls`: lists cluster pins
  - `/api/v0/pin/update`: updates cluster pin
  - `/api/v0/repo/stat`: shows repo/stat aggregates for the full cluster
  - `/api/v0/add`: adds to cluster.
- Cluster as "drop in"

API Clients and integrations

- Go client (as part of IPFS Cluster, used by `ipfs-cluster-ctl`)
- Javascript client (by @vasa-develop)
- pinbot-irc: Uses go client to pin things on Cluster from an IRC channel
- ipfs-hubot: Uses the IPFS Proxy API and js-ipfs-api to pin things in Cluster
- cluster-labs/horizon : A Web UI using the javascript client and REST API.


Thank You!