dCache.org

dCache+CEPH

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dCache User Workshop, Umeå, Sweden

Fermilab

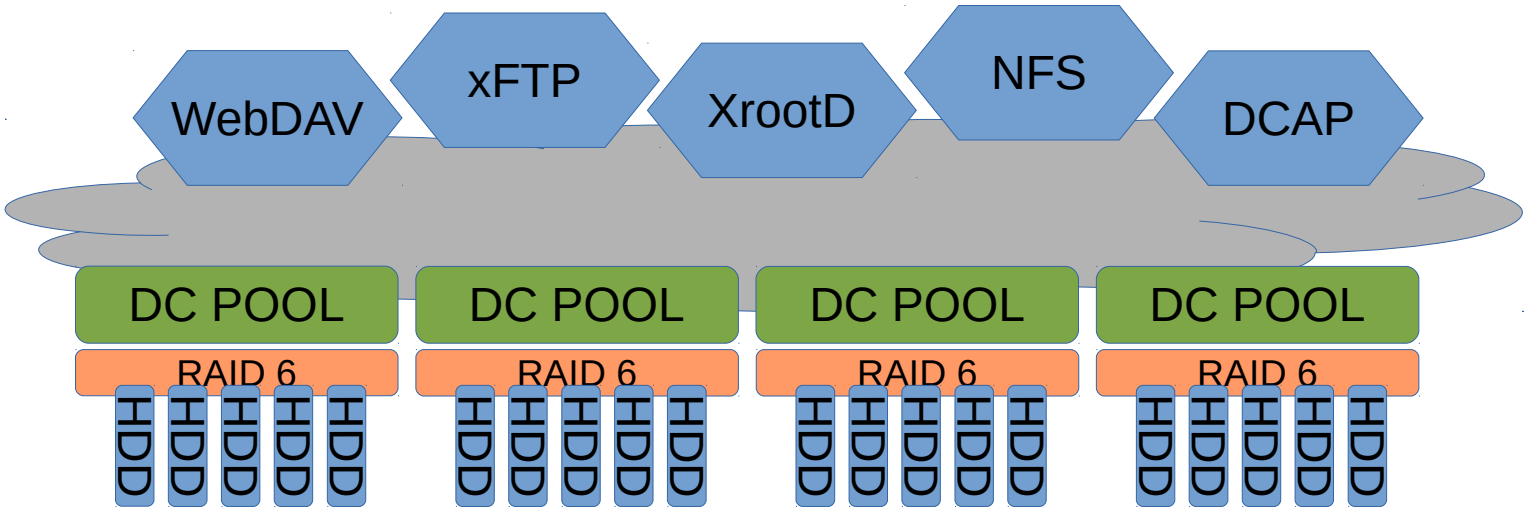
NDGF
Nordic DataGrid Facility

INDIGO - DataCloud
Better Software for Better Science

DESY

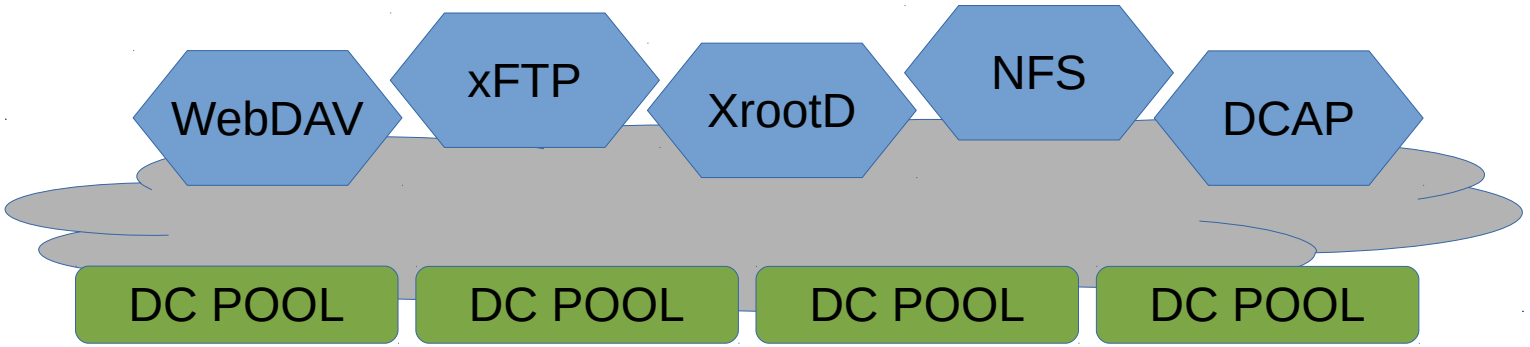
HELMHOLTZ
ASSOCIATION

Agenda (from)

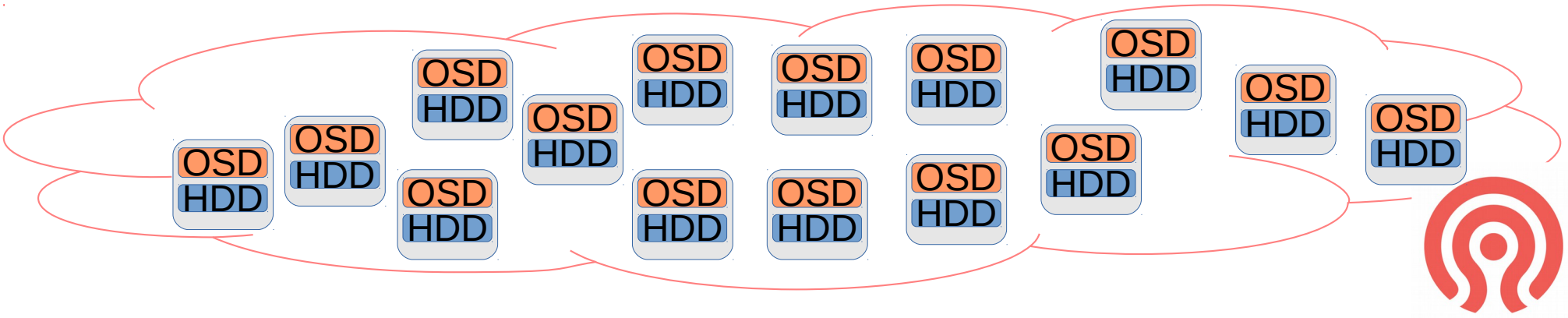


dCache

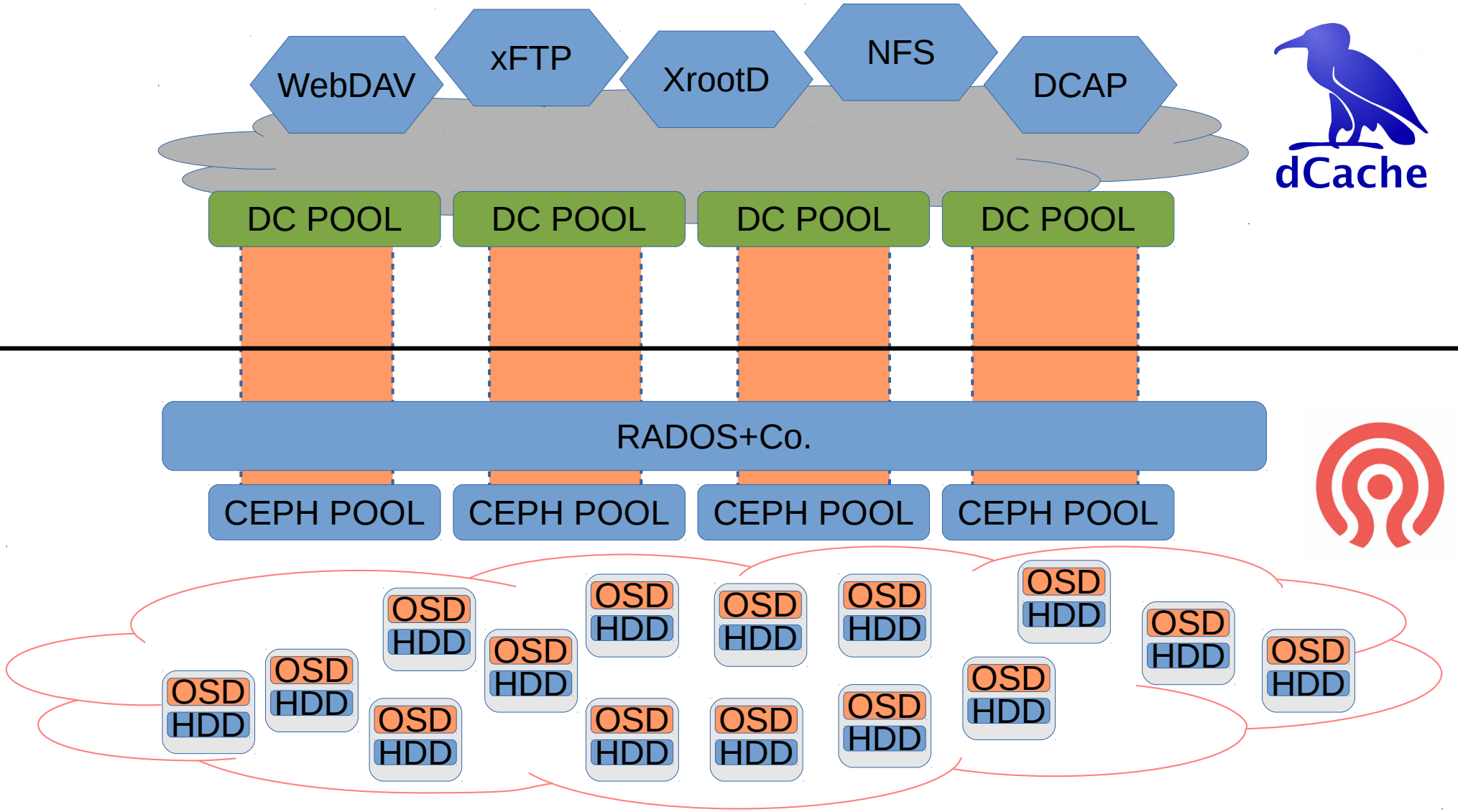
Agenda (to)



dCache



Final result

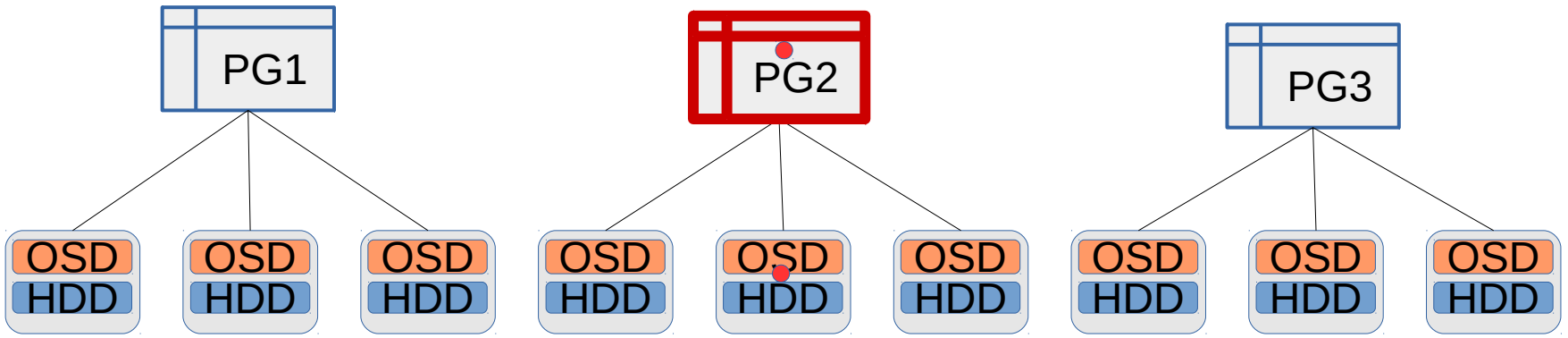


Why CEPH?

- Demanded by sites
  - deployed as objects store
  - used as back-end for OpenStack and Co.
- Possible alternative for RAID systems
  - no rebuilds on disk failure
  - one disk per OSD
  - allows to use JBODs and ignore broken disks

CRUSH in Action

HASH(Object) % 3 = 2



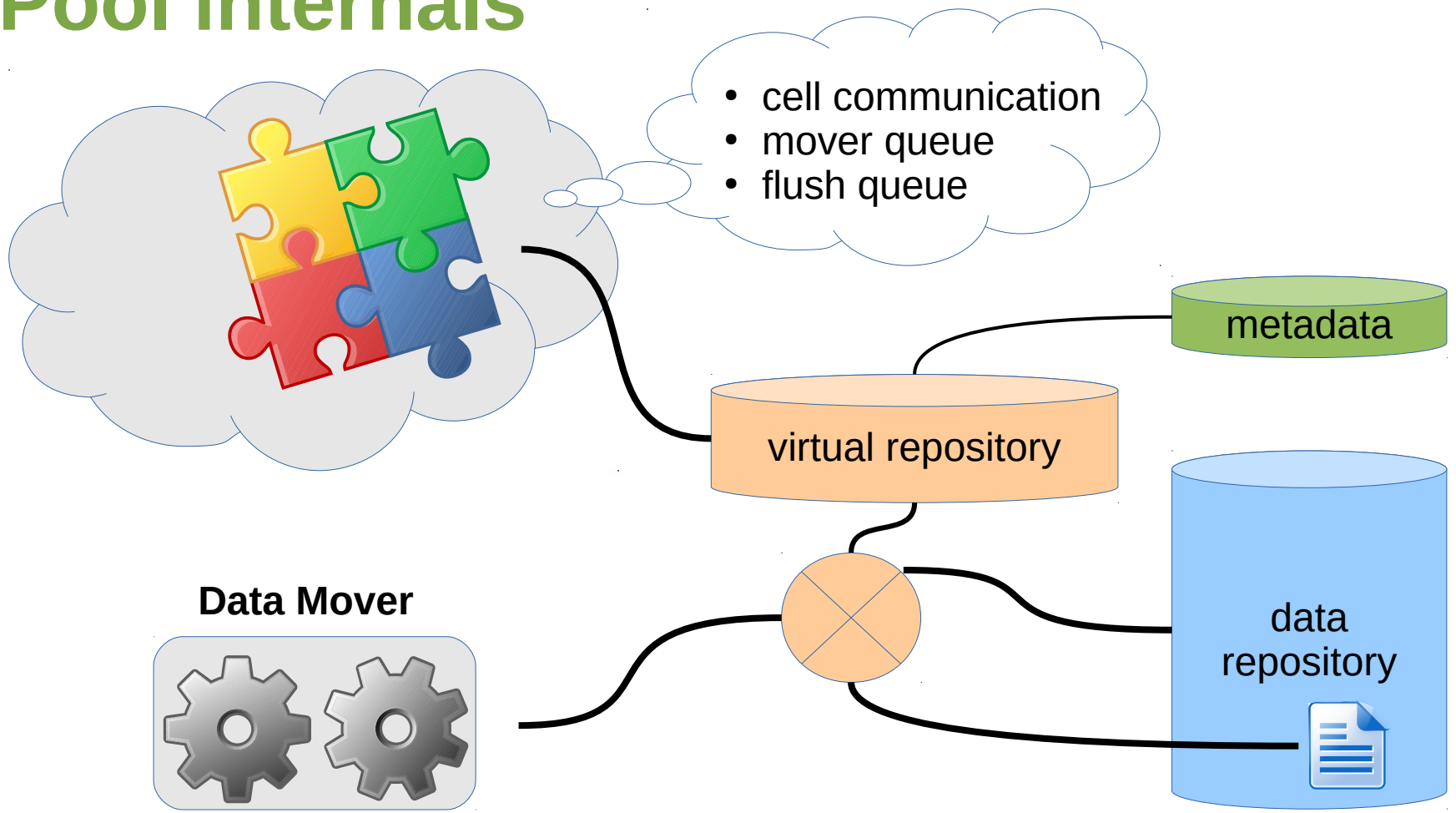
BUT, not only CEPH

- CEPH specific code only ~400 lines
- Other object store can be adopted
  - DDN WOS
- Swift/S3/CDMI
- Cluster file systems (as a side effect)
  - Luster
  - GPFS
  - GlusterFS

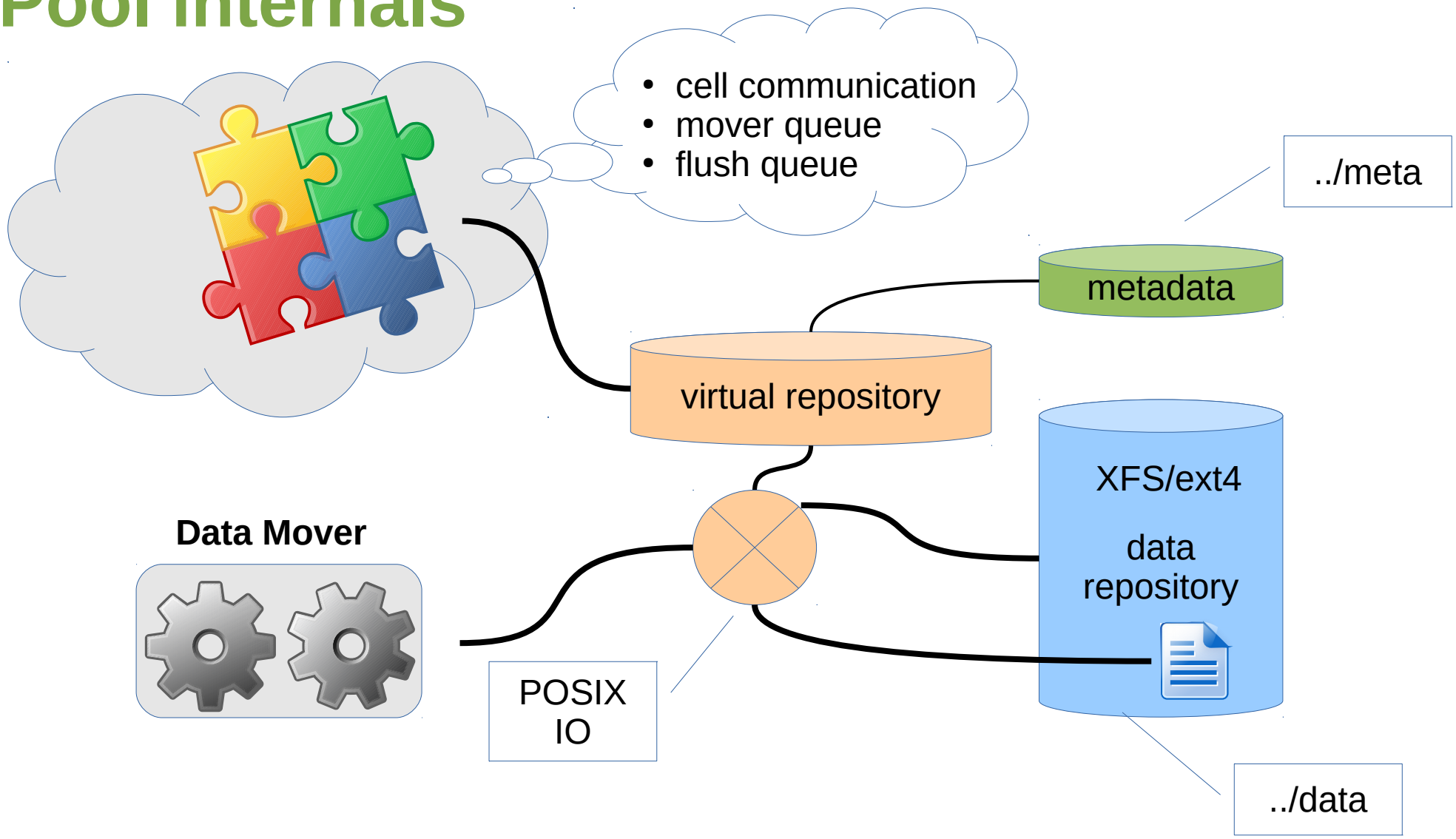
How it works?

- Pool still keeps it's own meta
  - File state, checksum, etc.
- All IO requests forwarded directly to CEPH
- Each dCache pool is a CEPH ***pool***
  - resilience
  - placement group
- Each dCache file is a ***RBD image*** in CEPH
  - striping
  - write-back cache
  - out-of-order writes

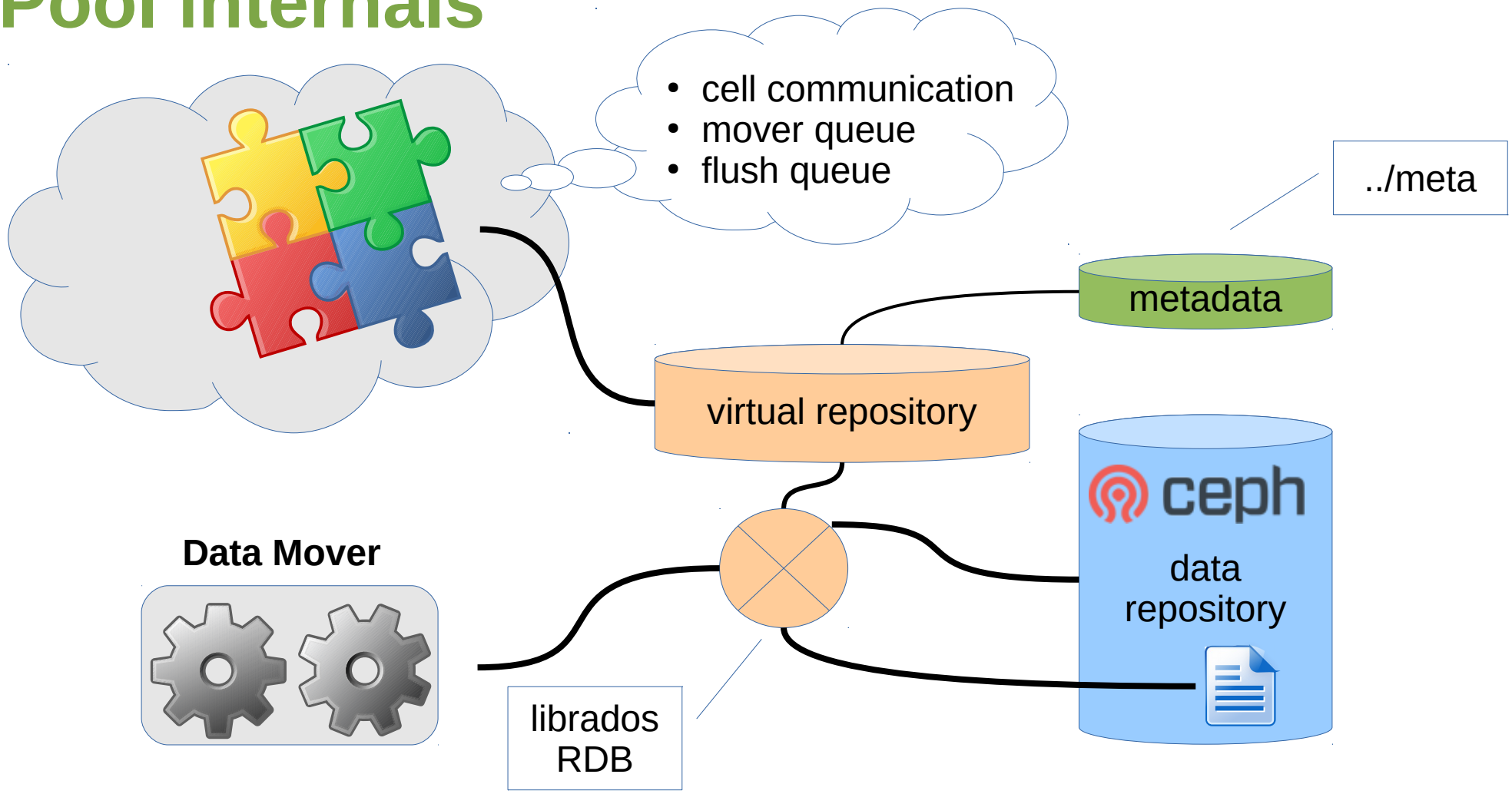
Pool internals



Pool internals



Pool internals



dCache setup

```
# layout.conf
pool.backend = ceph
# optional configuration
pool.backend.ceph.cluster = dcache
pool.backend.ceph.config = /.../ceph.conf
pool.backend.ceph.pool-name = pool-name
```

On the CEPH side

```
$ rados mkpool pool-name ....

$ rbd ls -p pool-name
0000000635D5968A4DD89E29C242185B2D82
0000001A770D854E41448D87C91822D90F0F
....
$
```

HSM script

- file:/path/to/pnfsid
  - shortcut to /path/to/pnfsid
- backend://
  - rbd://<pool name>/pnfsid

All files accessible in CEPH without dCache

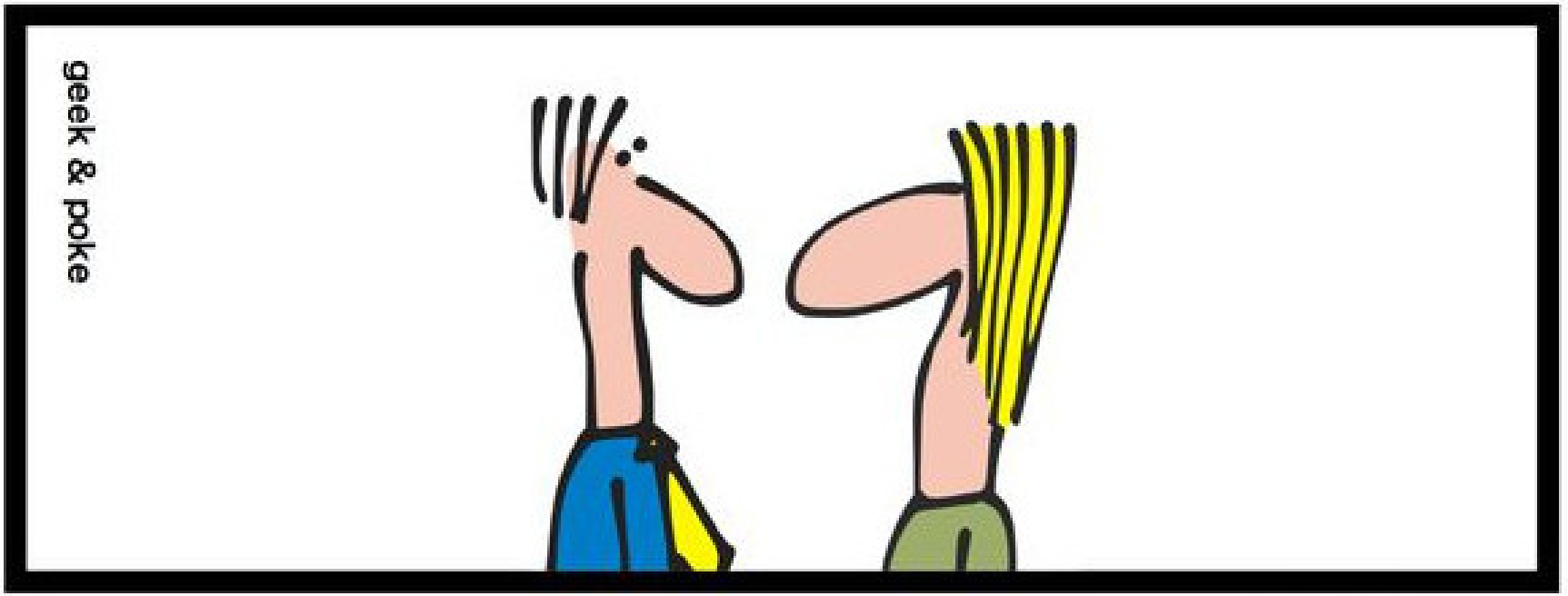
Current Status

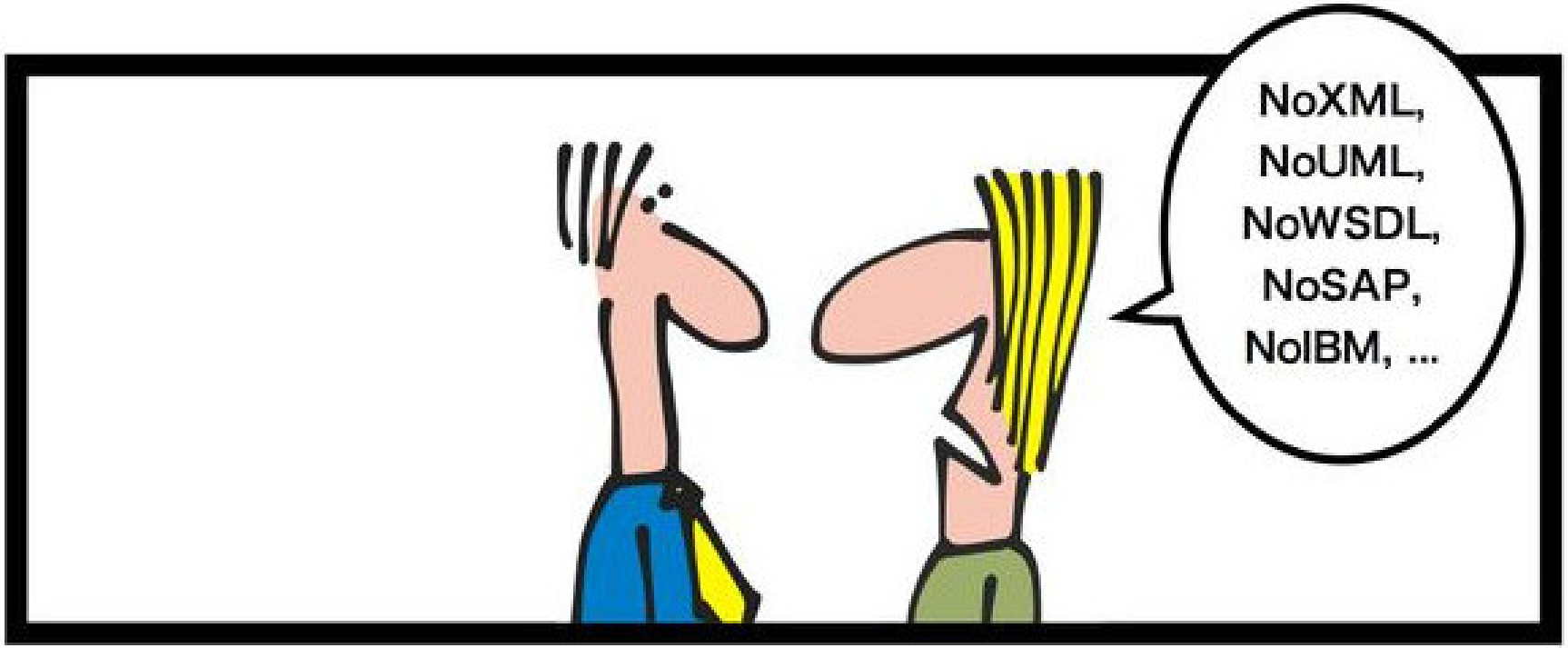
- Part of dCache-3.0
- Focus on stability and functionality first
  - all existing dCache feature set must be available
- uses RBD interface
  - striping
  - write-back caching
  - alterable content
- Thanks Johan Guldmyr for testing!
  - all (known) issued are fixed 3.0.4 & 3.0.13
- Part of my testing infrastructure
- Still missing on-the-field instance

Lightning talk #1

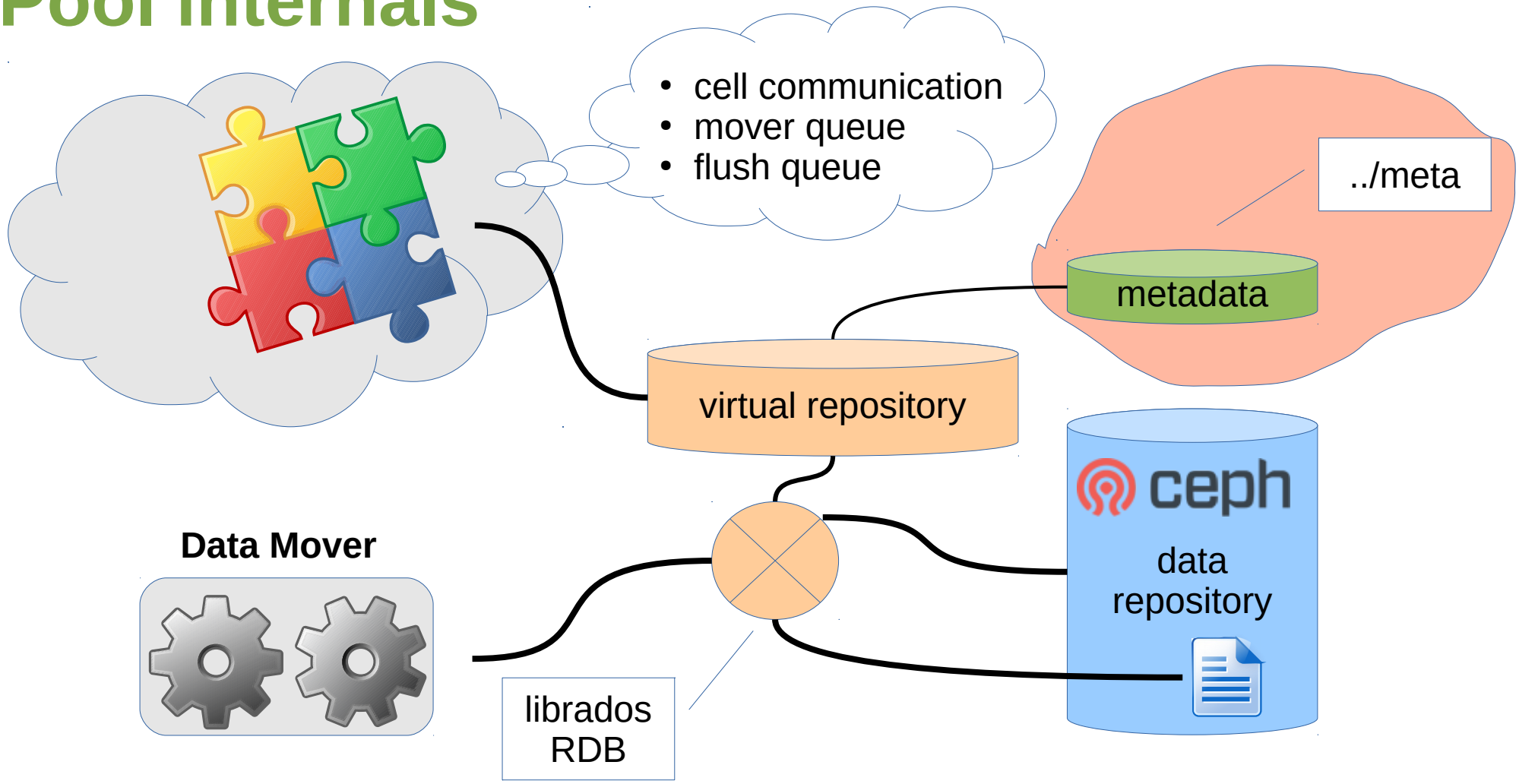
(SQL or noSQL?)


RECENTLY DURING THE JOB INTERVIEW
OK. You are an expert in NoSQL. Are there any other technologies you know well?
Of course!


geek & poke


NoXML,
NoUML,
NoWSDL,
NoSAP,
NoIBM, ...

Pool internals



Remote Metadata (oh, no!)

pool.plugins.meta=

o.d.p.r.m.m.MongoDbMetadataRepository

pool.plugins.meta.mongo.url=

mongodb://nodeA:27017,nodeB:27017

pool.plugins.meta.mongo.db=pdm

Bonus!

```
> db.poolMetadata.findOne()
{
    "_id" : ObjectId("5901d0dcd23064c72fec70dd"),
    "pnfsid" : "0000852CC74061FF4669B3F3DD0D0F0DA468",
    "pool" : "dcache-lab001-A",
    "version" : 1,
    "created" : NumberLong("1493290829481"),
    "hsm" : "osm",
    "storageClass" : "<Unknown>:<Unknown>",
    "size" : NumberLong(801954),
    "accessLatency" : "NEARLINE",
    "retentionPolicy" : "CUSTODIAL",
    "locations" : [ ],
    "map" : {
        "uid" : "3750",
        "gid" : "3750",
        "flag-c" : "1:bbfc21ed"
    },
    "replicaState" : "PRECIOUS",
    "stickyRecords" : {}
}
```

Aggregation: Files with #replica > 1

```
> db.poolMetadata.aggregate(
  {"$group":
      {"_id": "$pnfsid", "count": {"$sum": 1}}
  },
  {"$match":
      {"count": {"$gt": 1} }
  }
)
```

{ "_id" : "000053626EFD641344CF98674F2DB177A557", "count" : 2 }
{ "_id" : "0000DA769FF39DB645D98C2FBCBCB03940D1", "count" : 2 }
{ "_id" : "00004FB135CB3D5D44A4A01A6986D0FC379F", "count" : 2 }
{ "_id" : "0000180828ED01F248B2932D803988BAAD68", "count" : 2 }
{ "_id" : "0000F47168DD3FDE41D1882397AF1F5605B9", "count" : 2 }
{ "_id" : "000081F065EE796E4895BB4A7808A723588C", "count" : 2 }
{ "_id" : "0000E00132BF82C54048885E534AA7E8098D", "count" : 2 }
{ "_id" : "0000A2434F3051D340B79DE69E76932B24E1", "count" : 2 }
{ "_id" : "0000987BE0D888E04E9598ABE826990D347B", "count" : 2 }
{ "_id" : "00002832C952394D4B4399D077DA8162F58D", "count" : 2 }
{ "_id" : "000051EC4E1A48B741E4830712869B0595E8", "count" : 2 }

MapReduce: total sizes by state

```
> db.poolMetadata.mapReduce(
    function (){
      emit(this.replicaState, this.size);
    },
    function(k, v) {
      return Array.sum(v)
    },
    {
      out:{inline : 1}
    }).results
```

```
{
  "_id" : "BROKEN",
  "value" : NaN
},
{
  "_id" : "CACHED",
  "value" : 2635758434
},
{
  "_id" : "PRECIOUS",
  "value" : 1834228442752
}
```

Summary

- Distributed metadata required for pools on shared storage
- NoSQL databases on possibility
- We are working on best solution
- Stay tuned!


dCache

Links

- https://www.dcache.org/
- https://en.wikipedia.org/wiki/Software-defined_storage
- http://ceph.com/

CEPH vocabulary

- OSD – object storage device
  - Minimal storage unit, usually a single disk.
- Primary-Affinity – primary OSD for a object
  - CEPH clients only read and write objects from/to PA.
  - Each OSD has a weight to be a PA
    - PA (HDD) == 0; PA (SSD) > 0 → all client IO from SSDs only
- RF – replication factor
  - Number of replicas per object.
- PG - placement group
  - Logical storage unit. Each object stored in a placement group. PG creates required number of object replicas on one or more OSDs.
- POOL – logical container,
  - contains one or more placement groups
  - Replication factors are assigned to POOLs
- CRUSH - Controlled Replicated Under Scalable Hashing
  - Each client uses CRUSH algorithm to find out object location based on cluster map, which contains list of OSDs
- MON – cluster coordination daemon.
  - The entry point for the clients to discover CRUSH-maps