dCache.org

dCache, managed Cloud Storage

@ CHEP ‘ 16

Patrick Fuhrmann

On behave of the project team

That's this about

- The Technology
- The Deployments
- The Collaboration
- The Funding influence on the development
- Design Principle
- Consequences of the design
- Improvements in Operations
  - Unbreakable
  - Adopt object stores
- Improvements for the customer
  - Quality of Service in Storage
  - Sync'n Share
- The ultimate scientific life cycle engine

Or ……. in other words …

In other words

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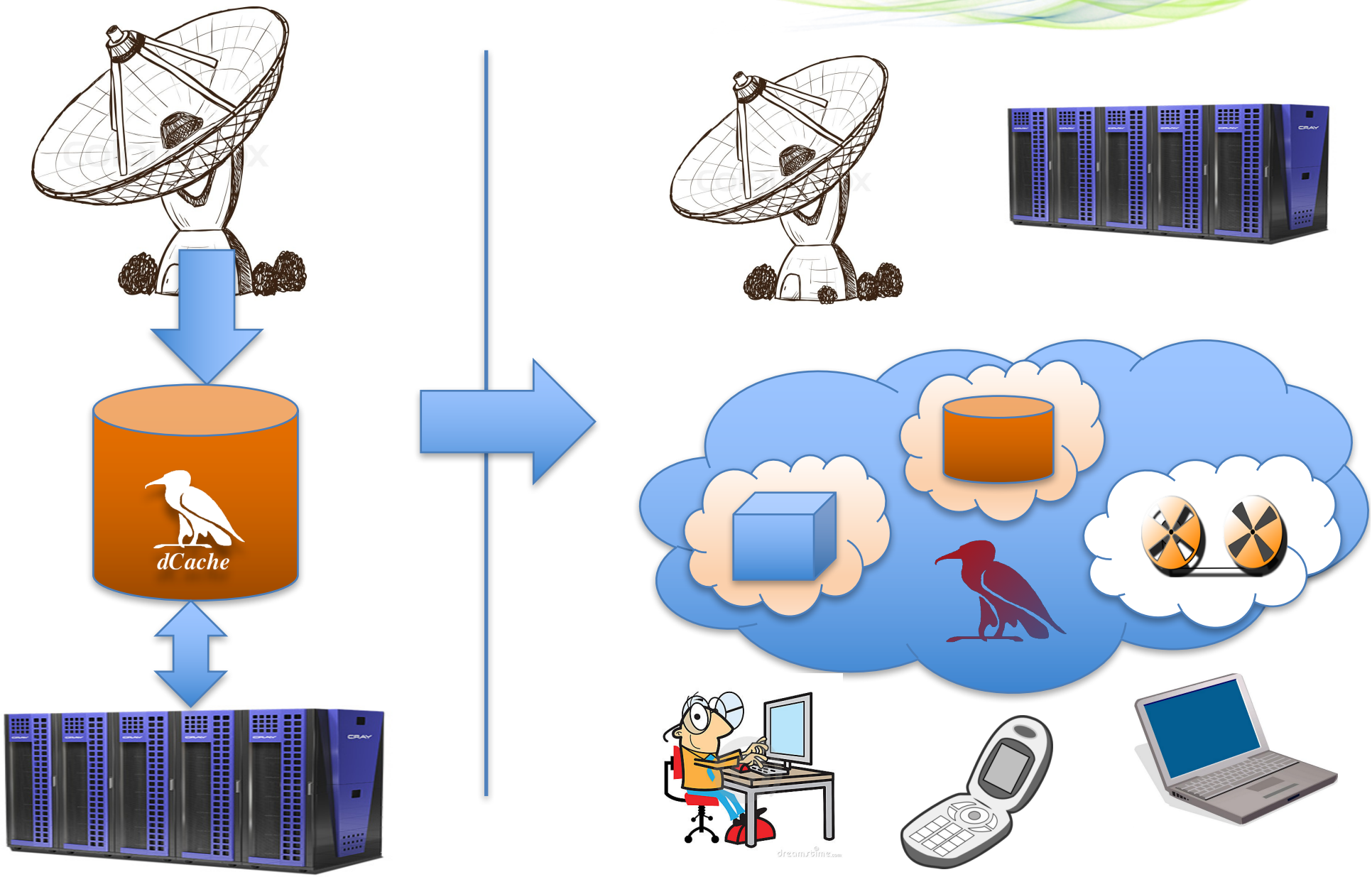

The Technology Cheat Sheet

dCache Cheat-sheet

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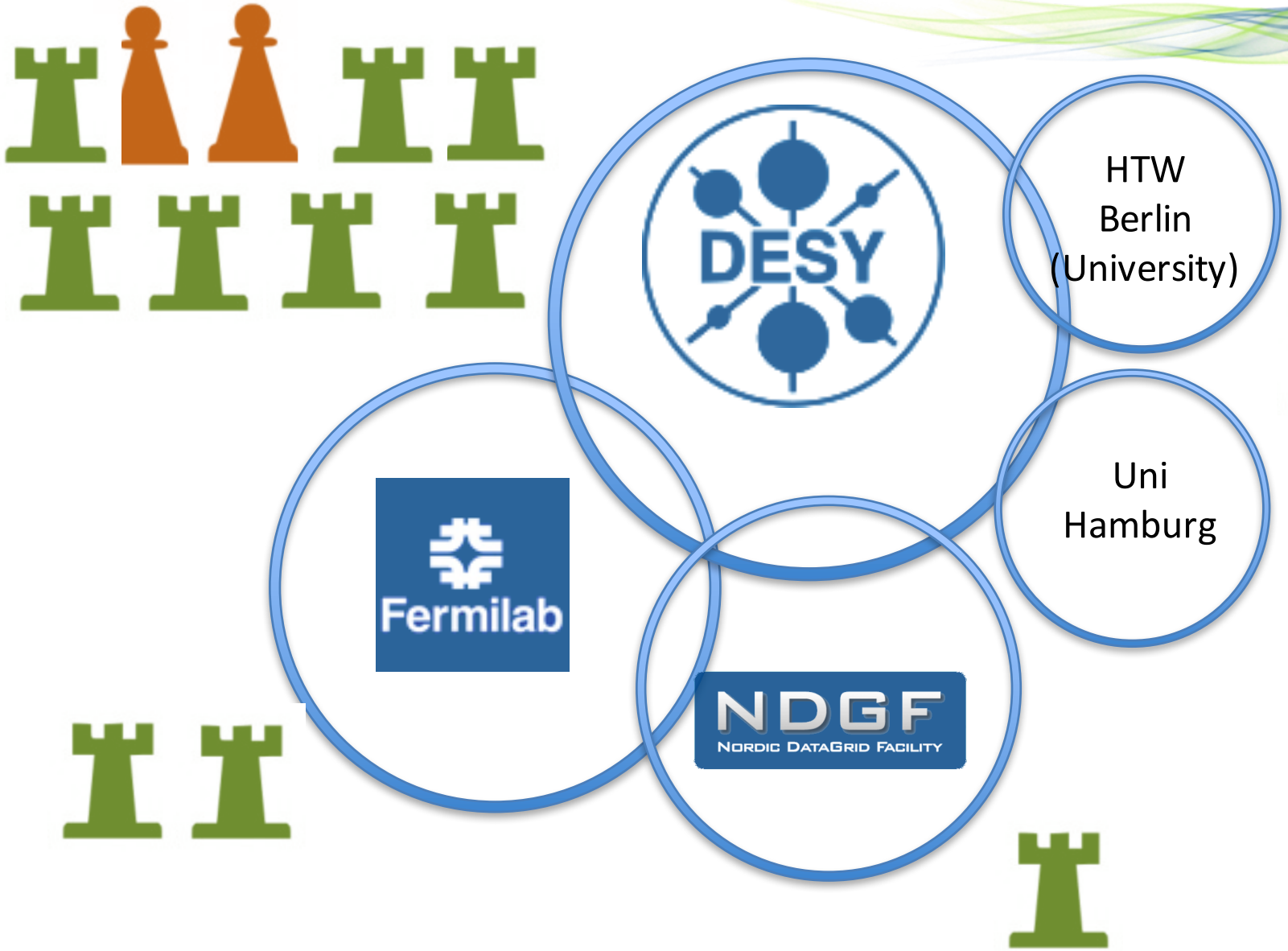
- Combines heterogeneous storage nodes under a common virtual file system tree and scales into 100PB region.
- Provides access to data via a variety of protocol, e.g. NFS4.1, WebDAV, GridFTP, etc.
- Provides a variety of authentication mechanisms, like User/Pass, X509 Certificates, Kerberos, in preparation SAML and OpenID Connect, Macaroons.
- Multi Tier support: moves data around between different media types, like Tape, Spinning Disks and SSDs.
  - By user request.
  - Automatically based on the access profile, hot spot.
- Provides resiliency, e.g. through multiple copies.

The Collaboration

The dCache.org collaboration

dCache.org



On funding and technical directions

Funding influences dCache development topics

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EUROPEAN MIDDLEWARE INITIATIVE

LSDMA

Standardization

2010

2013

NFS 4.1 / pNFS

HTTP / WebDAV

Contributing to the Dynamic Federation

Deploying new technologies into Production and exploring new communities

AAI

2015

2018

INDIGO DataCloud

Data Life Cycle

Multi Tier Storage

Quality of Service

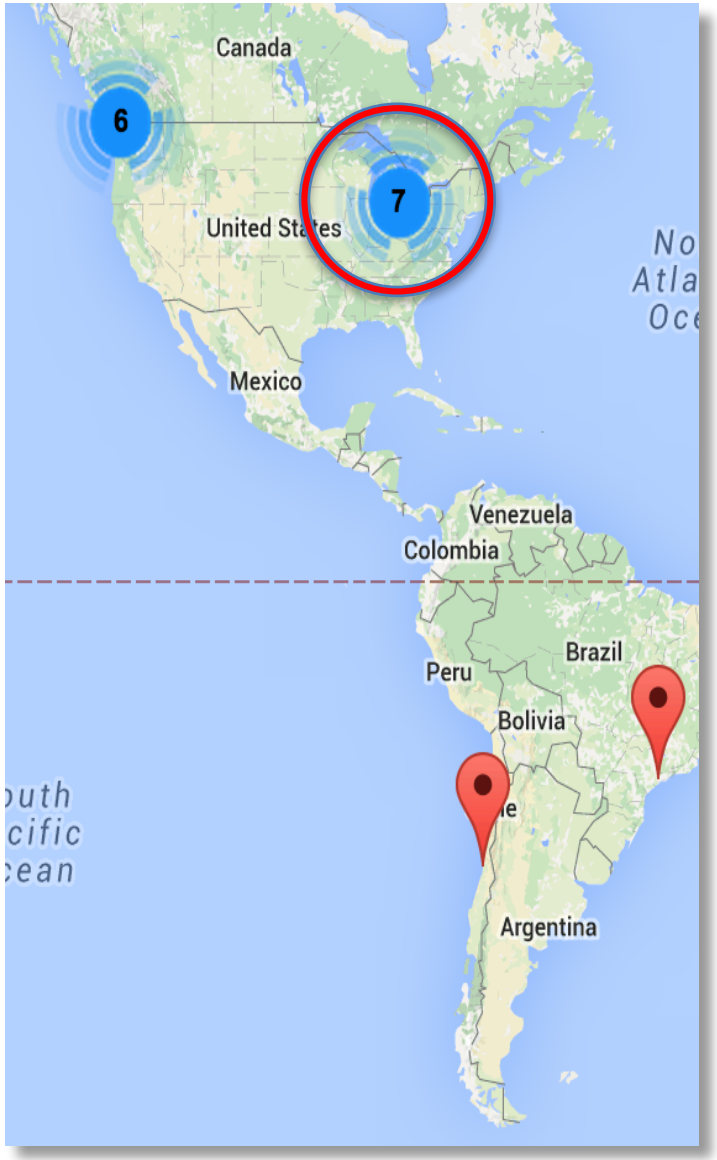
Migration Archiving

dCache Deployments

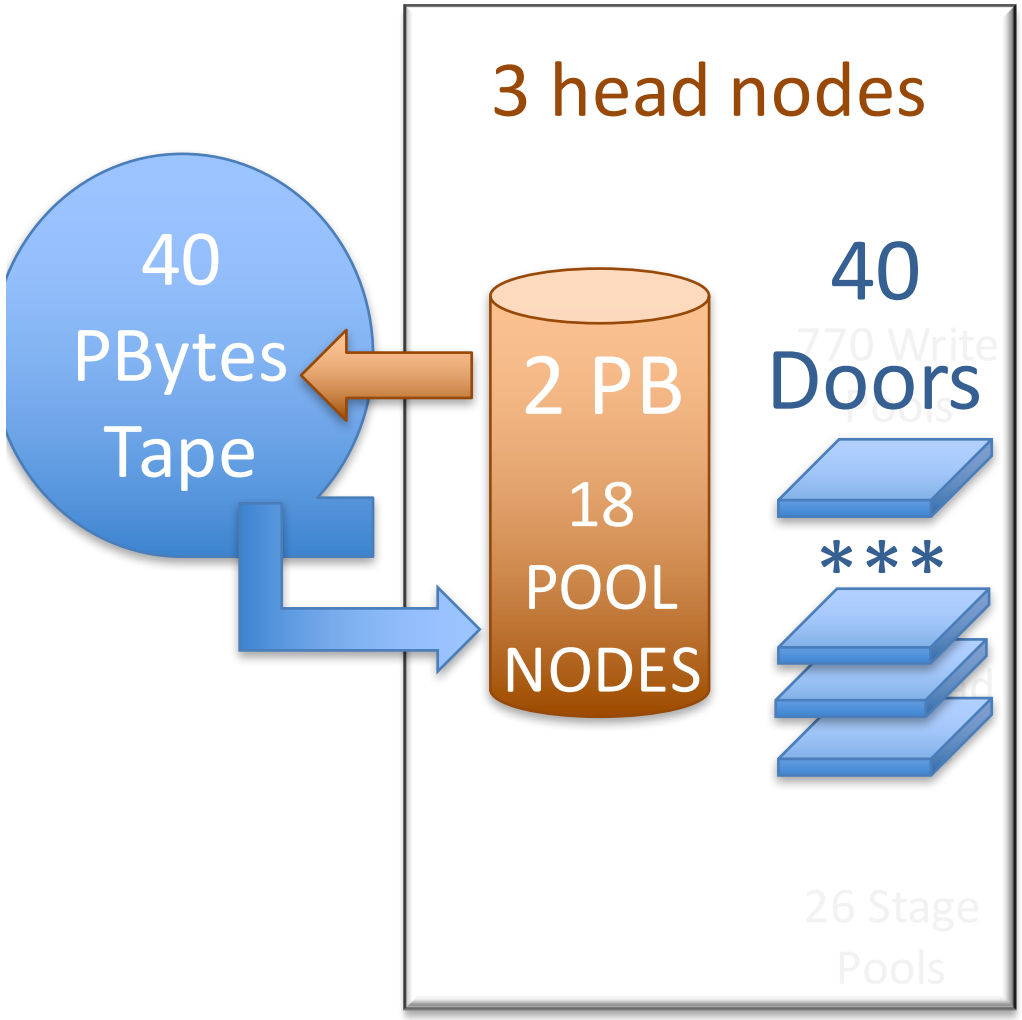
Huge, Wide and small

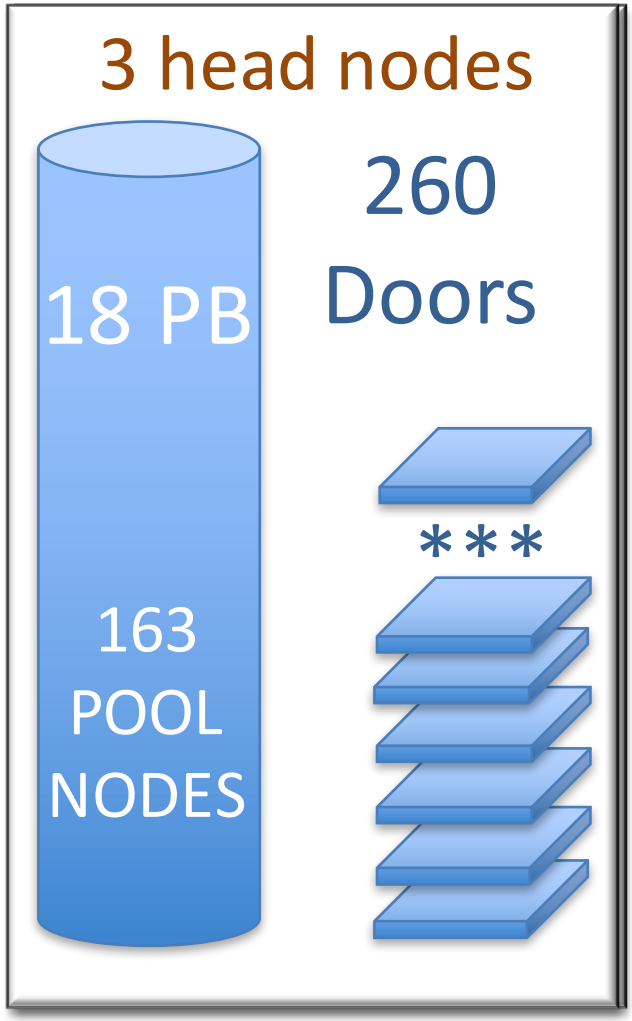
Worldwide distribution

Worldwide distribution



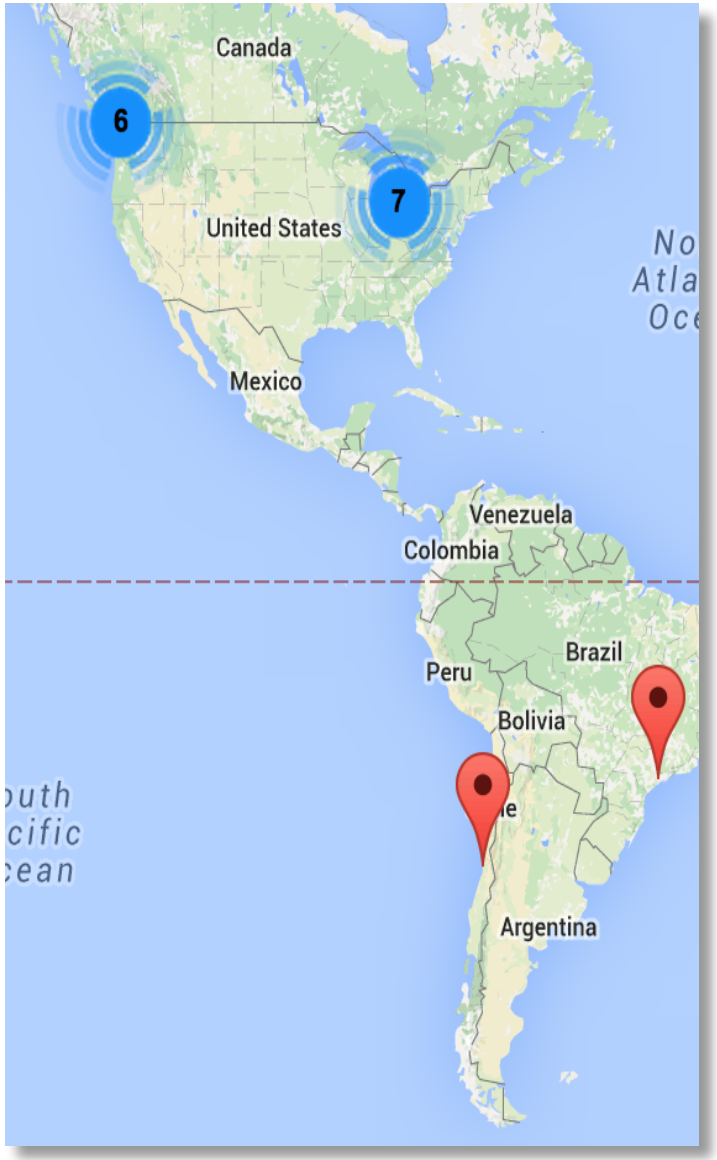
Starting with possibly the biggest US-CMS Tier I 18 PBytes on Disk

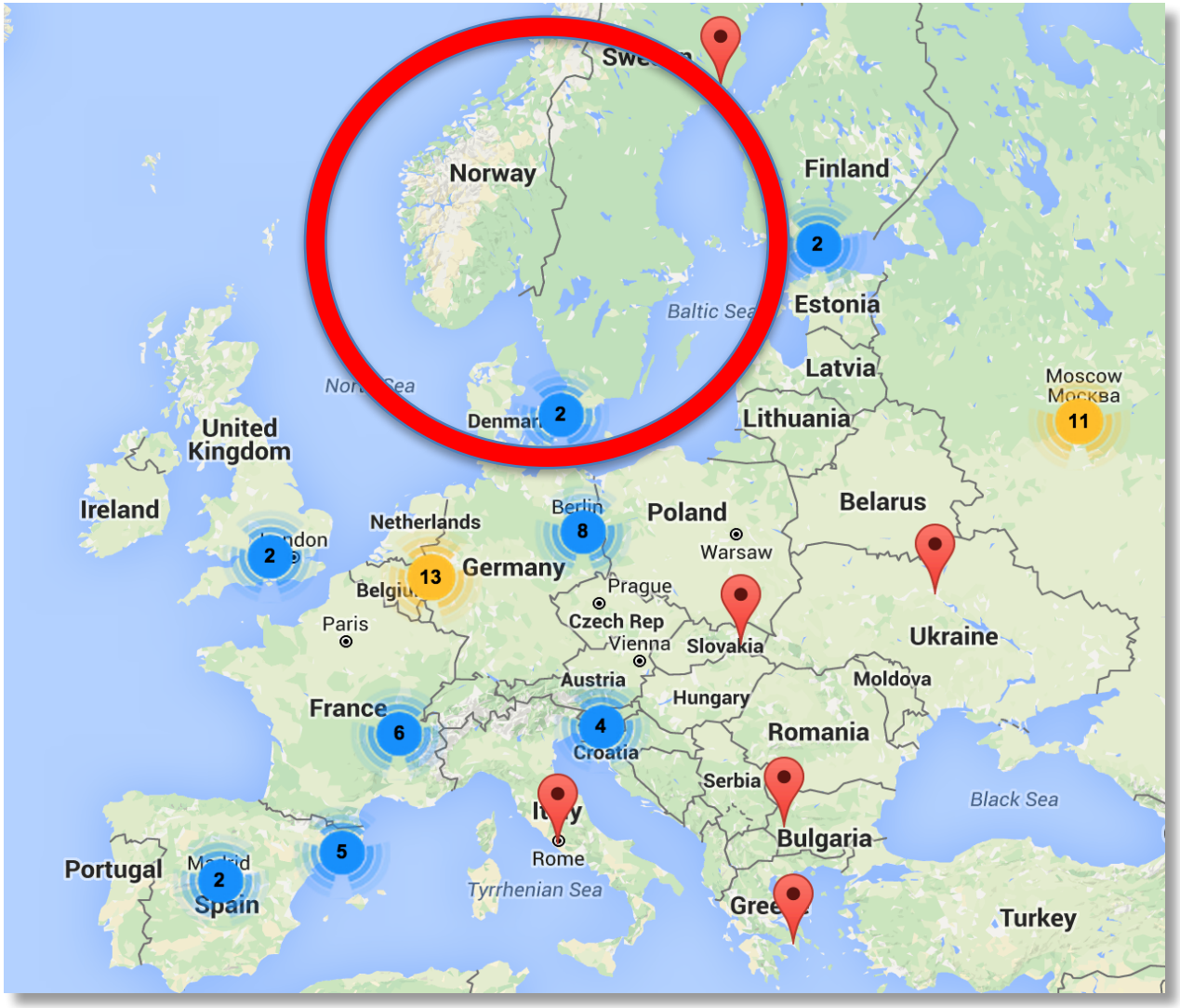




Information provided by Catalin Dumitrescu and Dmitry Litvintsev

Worldwide distribution





To certainly the most widespread

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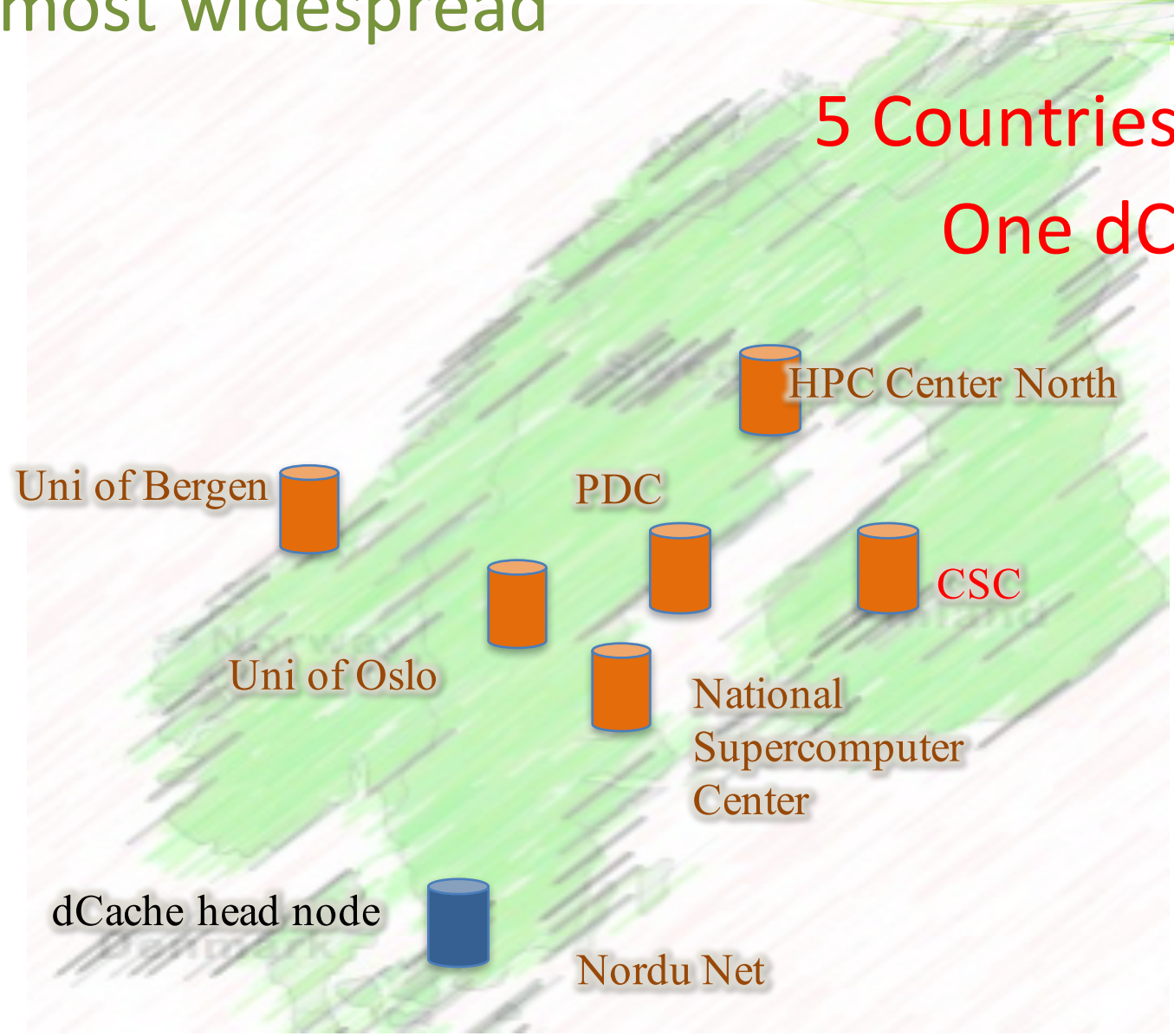
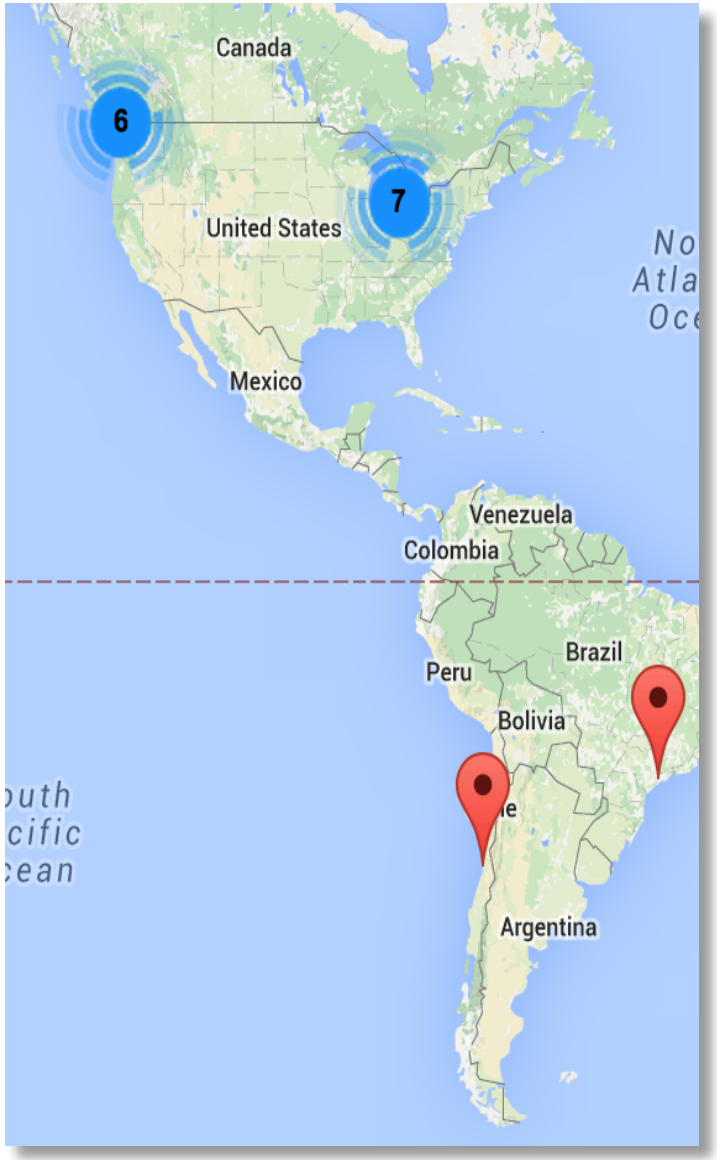


Slide stolen from Mattias Wadenstein, NDGF

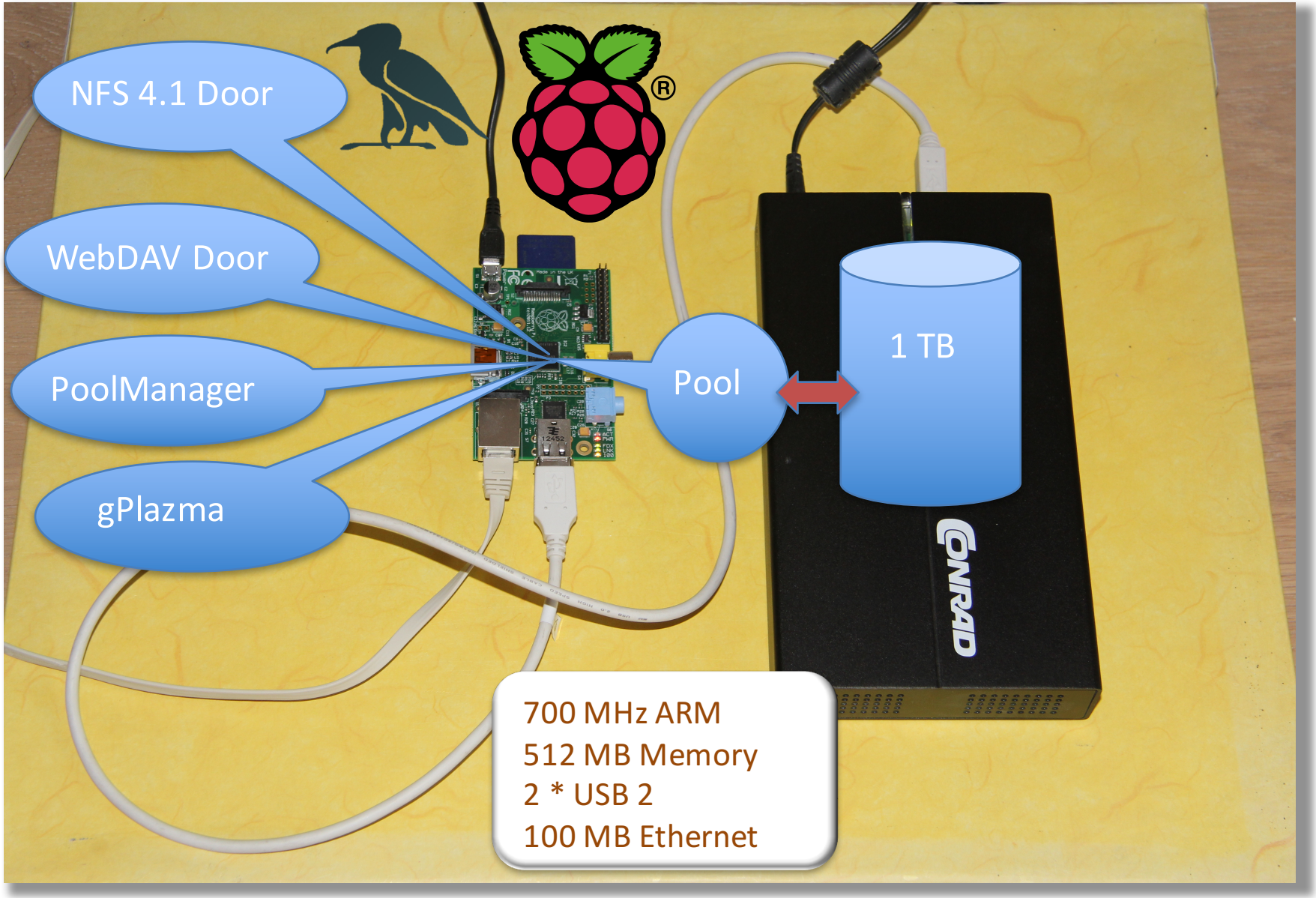
Worldwide distribution



Hamburg, Eimsbuettel

To very likely the smallest

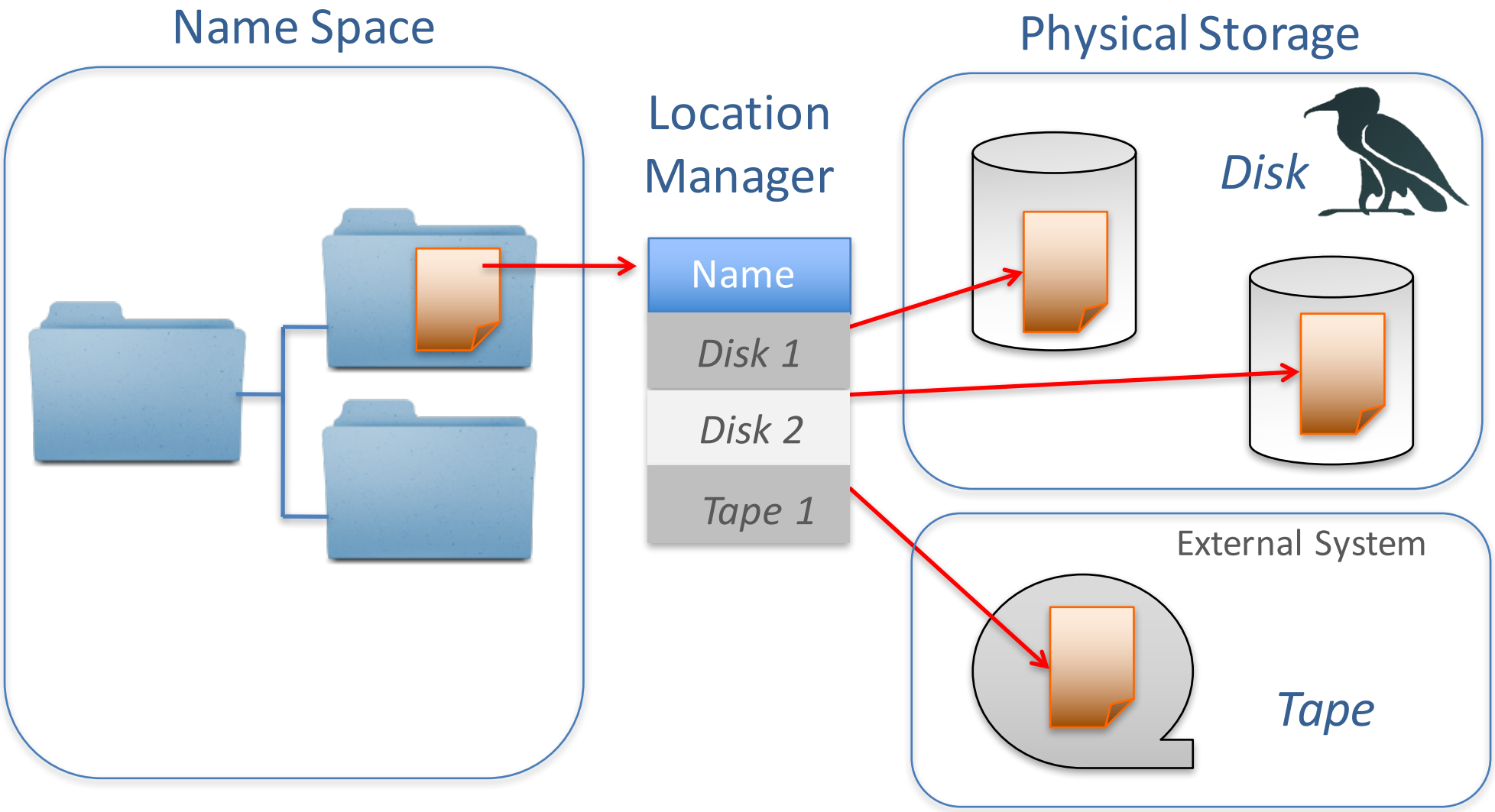
One Machine – One Process



Design Principles

Design

Namespace – Storage separation



Consequences of this design pattern ….

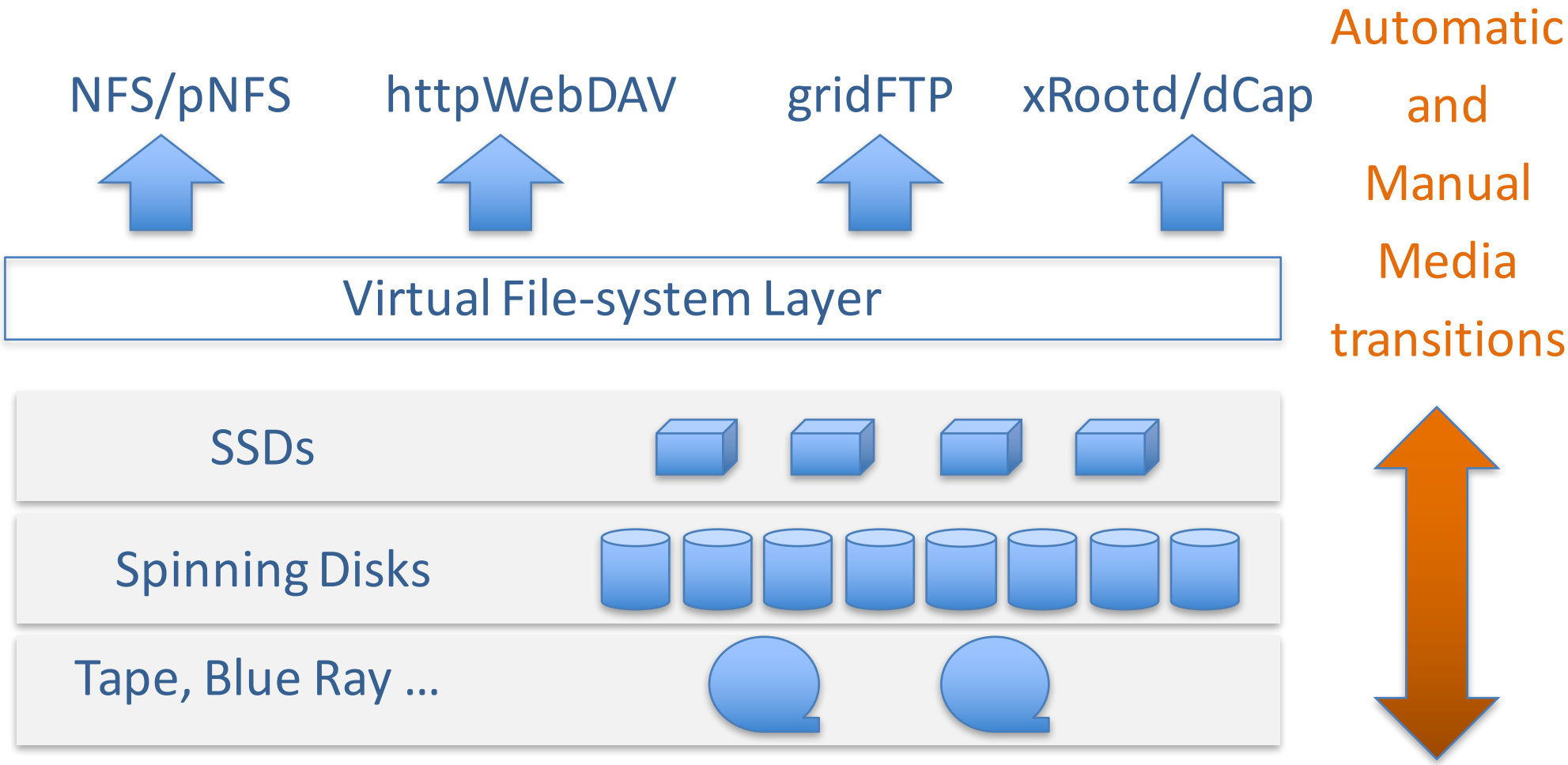
Consequence : Multi Tier support

SSD, Spinning, Disk, Tape, multiple file copies.

Design

Multi Tier support

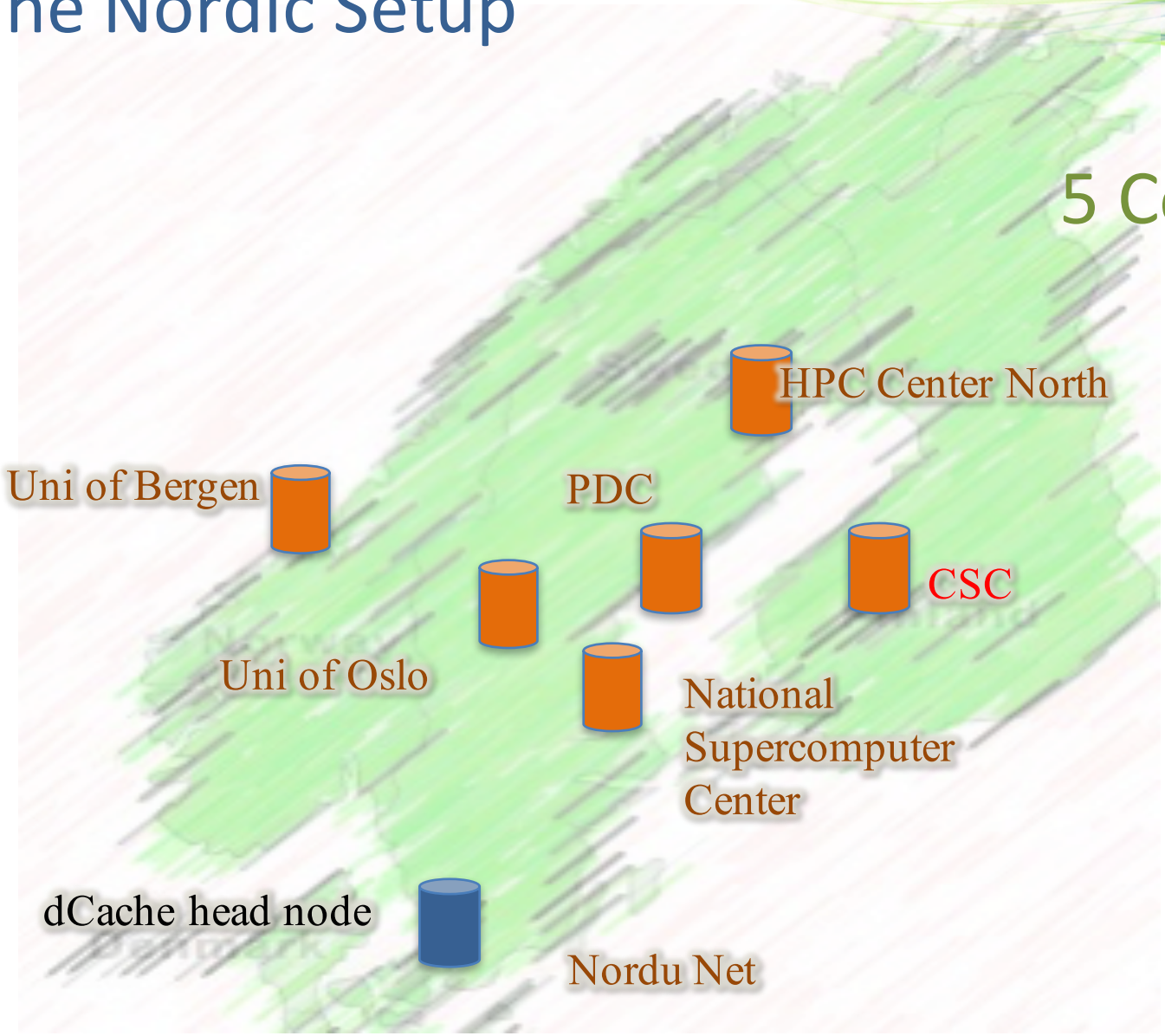
dCache supports multi-tier storage and transitions.



Consequence : Federated Storage Structures

Federating Storage

The Nordic Setup

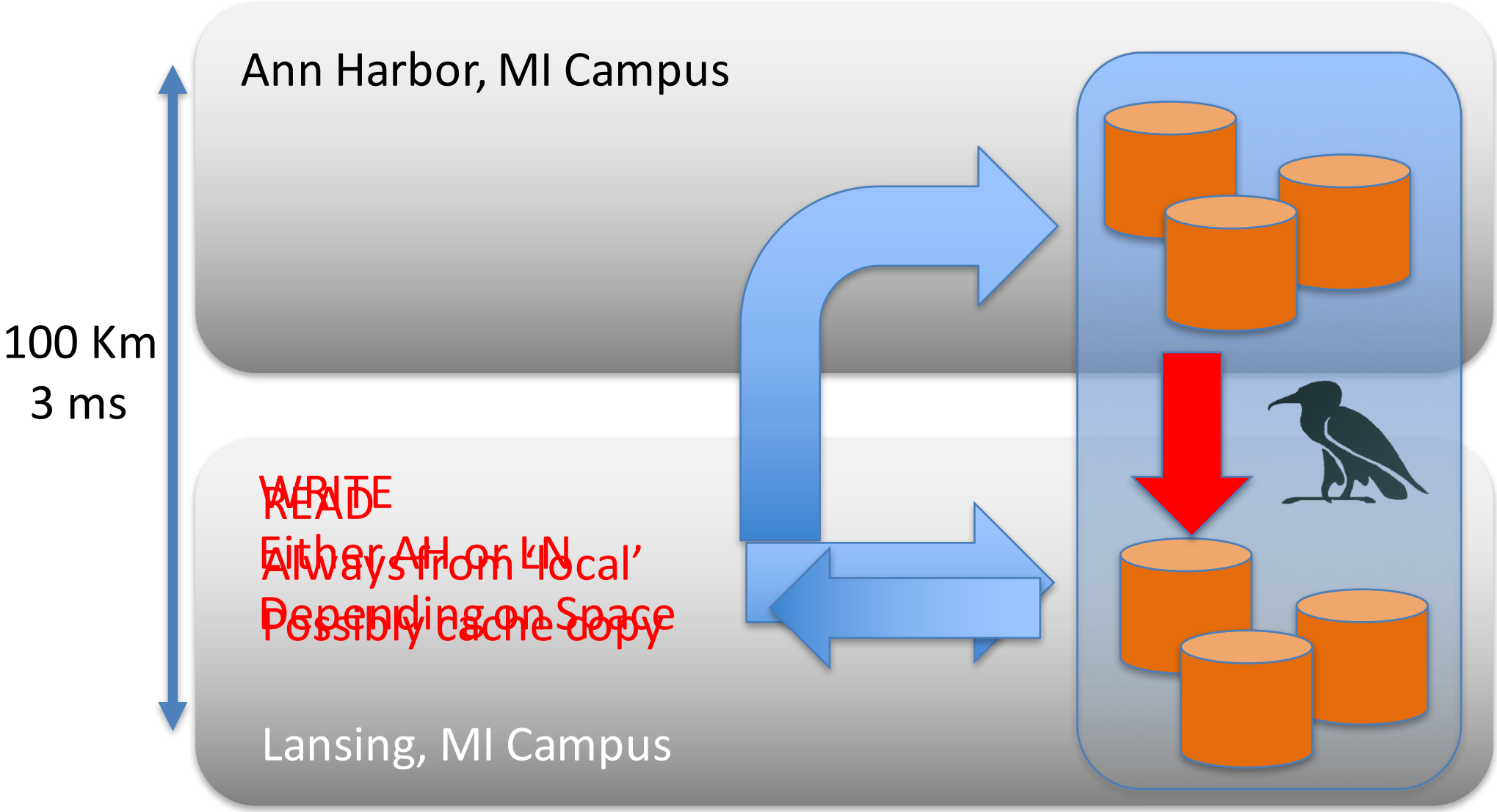


5 Countries

One dCache

Slide stolen from Mattias Wadenstein, NDGF

Federating Storage
The Michigan Setup



More consequences

- Hot spot detection and mitigation.
- Data migration to add or decommission hardware
- Resilient Manager : creating ‘n’ copies on different pools nodes to allow ‘n-1’ pools to fail before the system degrades.
- And many you can think of ….

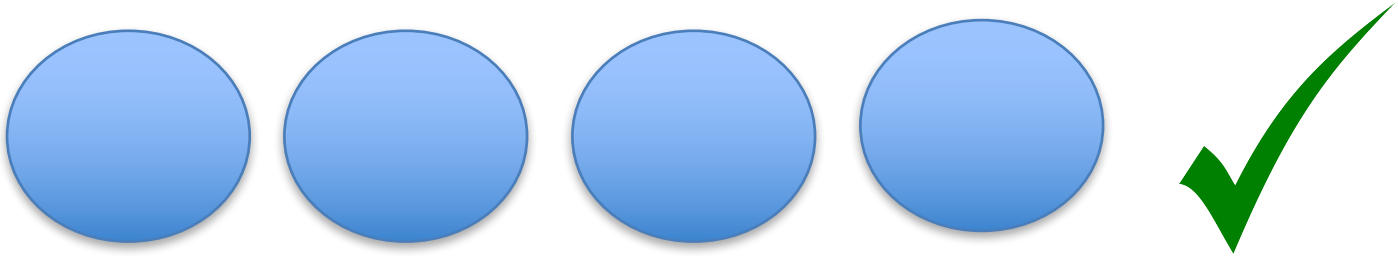
What do we need to make this even better suited for cloud applications ?

Improved operations (I)

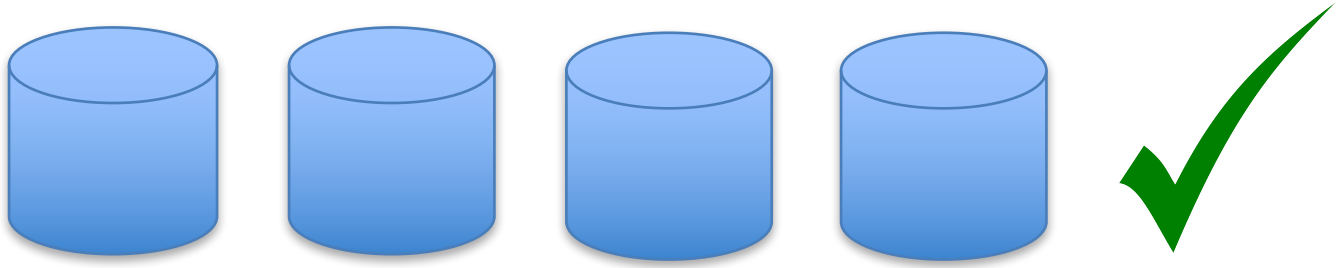
Make it unbreakable

High Availability

Redundant
Doors
(Protocol Engines)



Redundant
Pools
(Replica Manager)
Multiple File Copies

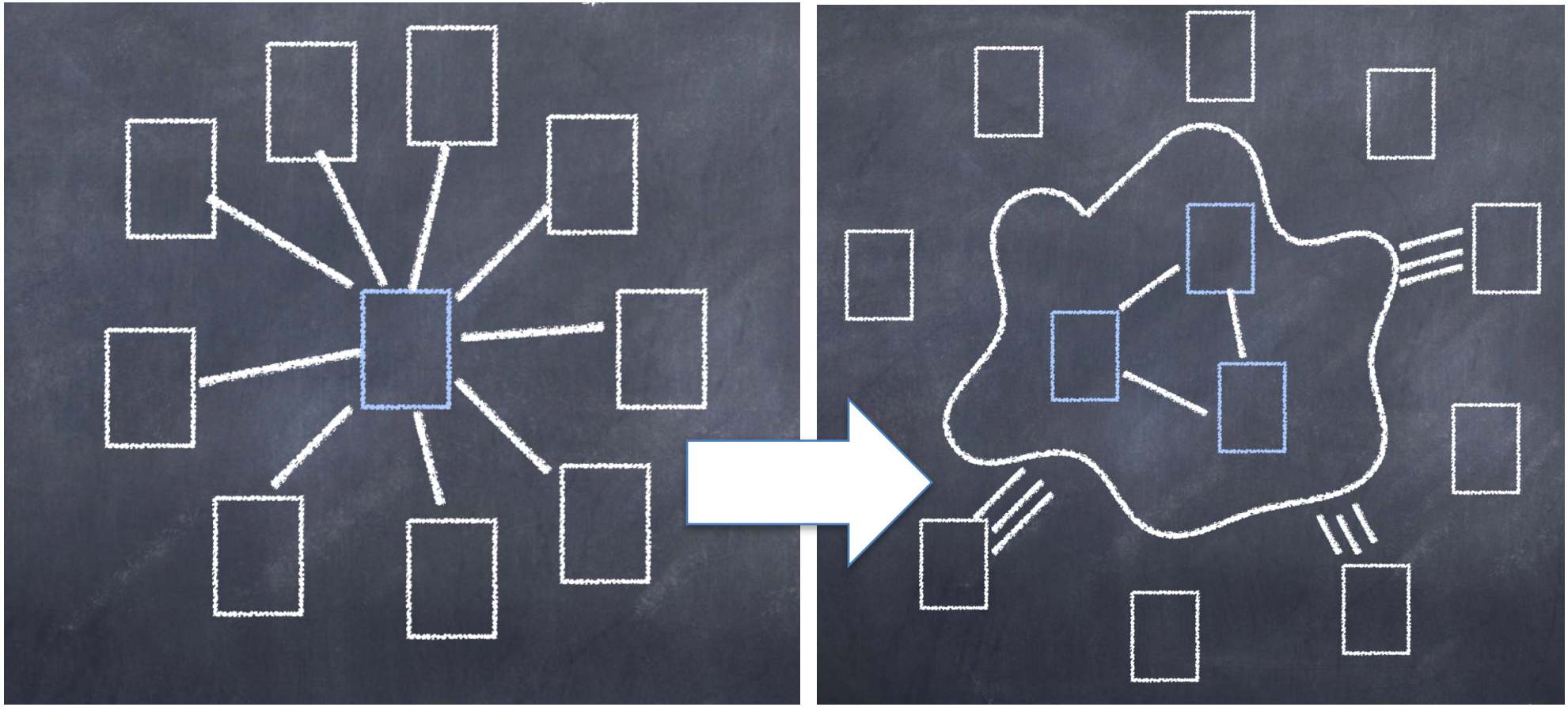


High Availability

Some remaining issues to fix ….

- The message passing has be fixed to overcome failures of an essential path segment. ‘rerouting’
- How do we make services redundant which are singletons ?
- How do we manage failures of state-less services ?

High Availability



Any single component can fail, w/o breaking the service

Stolen from Gerd Behrman, NDGF

High Availability

- Singletons (build quorums, e.g. using Zookeeper)

- Stateless services : use publish subscribe

High Availability

Result : at any point in time, one internal service (node) can fail without consequences on the overall service.

Essential for a huge 24/7 installation.

Improved operations (II)

Integrate scalable easy to maintain solutions e.g. CEPH

Delegating work to external Storage Layers

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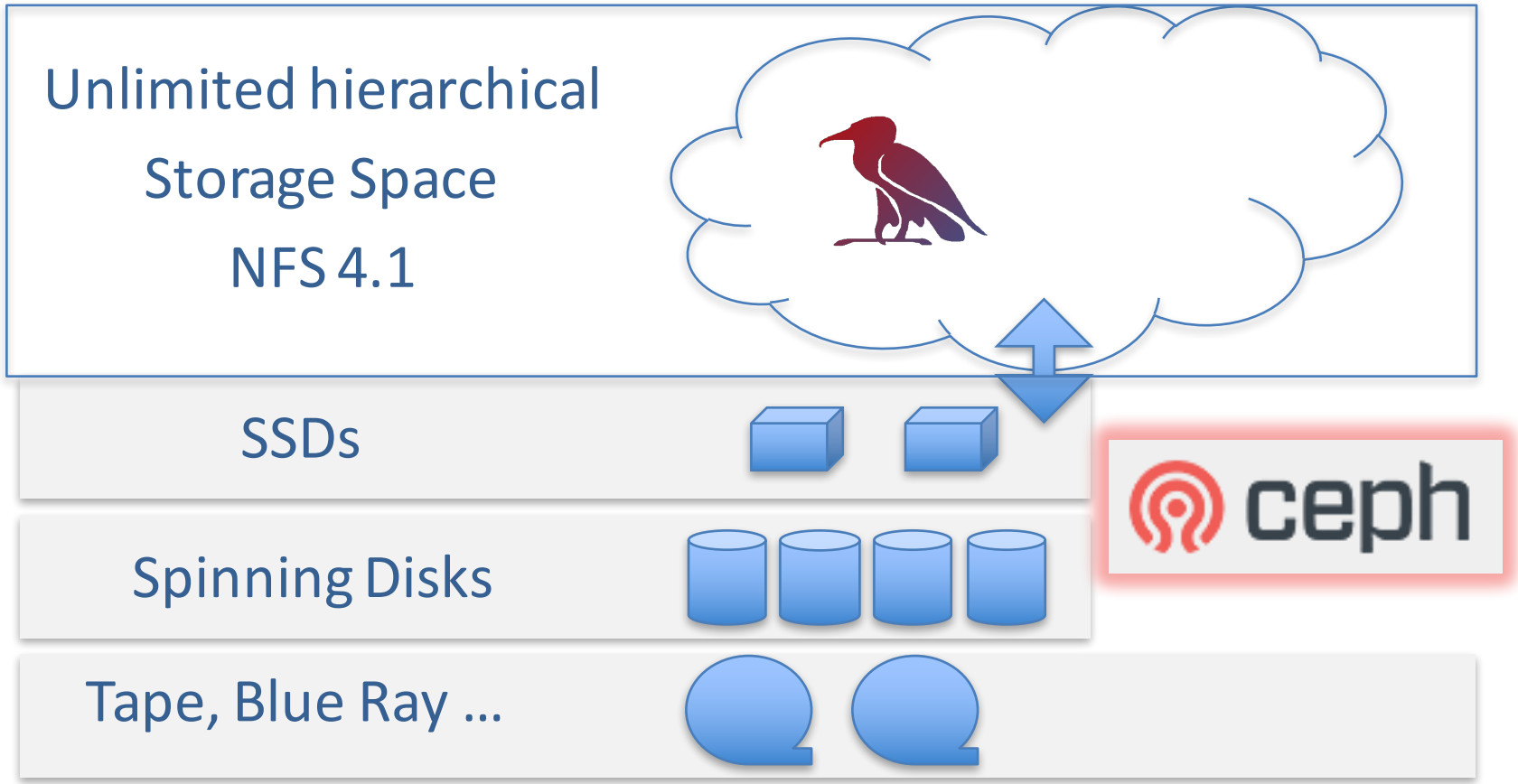
- Provides a single-rooted namespace.
- Metadata (namespace) and data locations are independent.
- Uniquely handles different Authentication mechanisms, like x509, Kerberos, login+password, auth tokens.
- Provides acces protocols (WebDAV, NFS DCAP).
- Provides data migration between multiple tiers of storage (DISK, SSD, TAPE).
- Aggregates multiple storage nodes into a single storage system.
- Manages data movement, replication, integrity.

Can be delegated

Slide stolen from Tigran Mkrtchyan

New Technologies in dCache



Improvements for the users (I)

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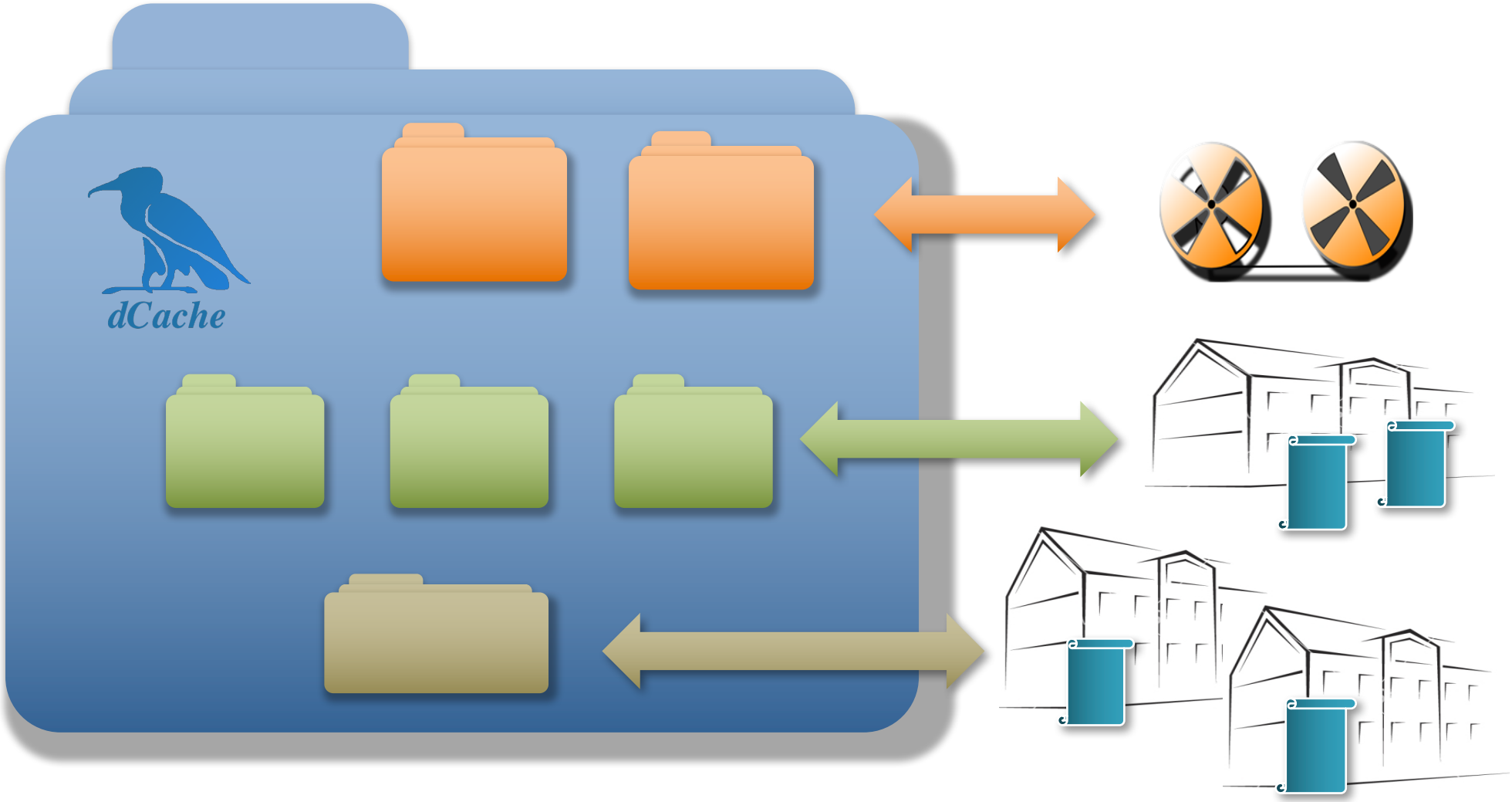
Storage has different qualities

- Example from home
  1. A ripped DVD is not really valuable but
  2. Pictures of your kids are irreproducible.
- There are similar examples in science e.g. collected earth climate data.
- Google and Amazon already provide different service levels in storage (e.g. S3 and Glacier)

We can do the same, even on directory basis.

Storage Quality selection



That was an easy one with dCache,

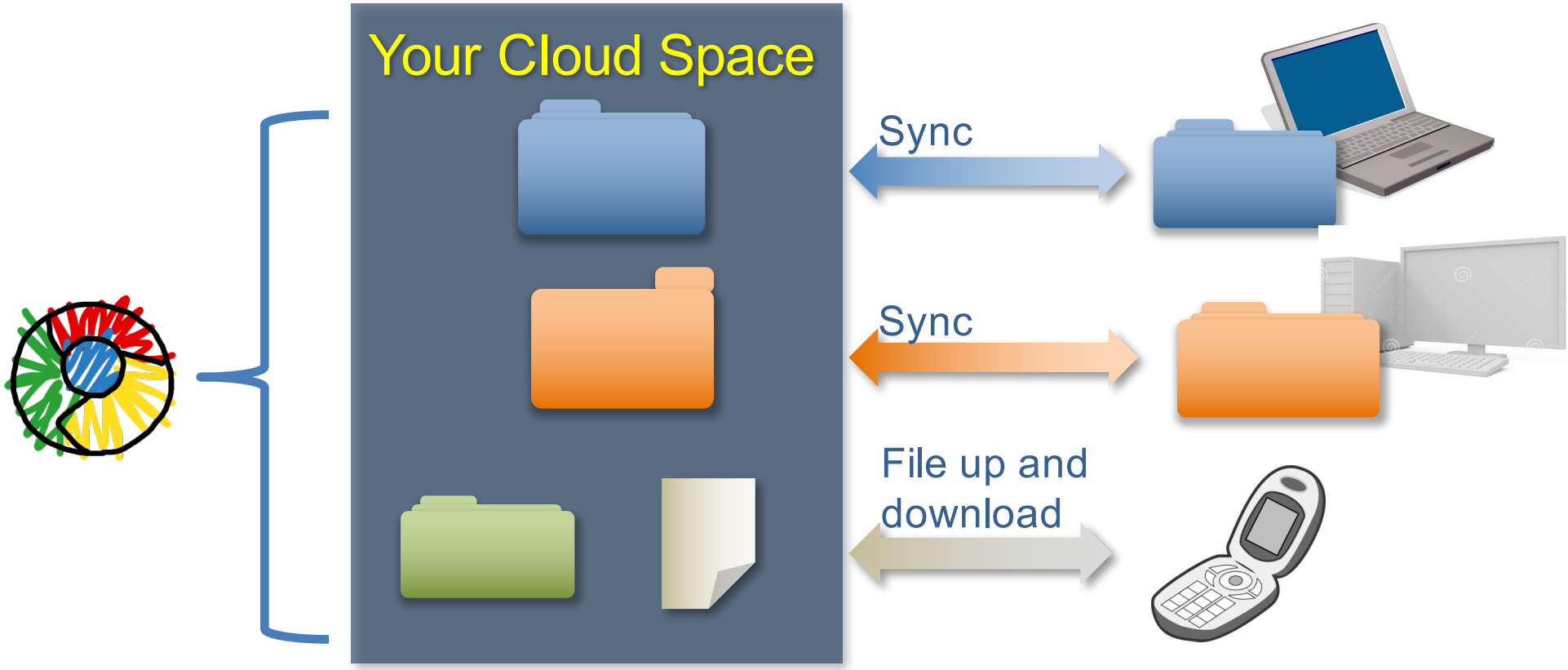
however

Make sure to store and analyse the billing information to charge customers for high quality storage, like multiple copies and tape usage.

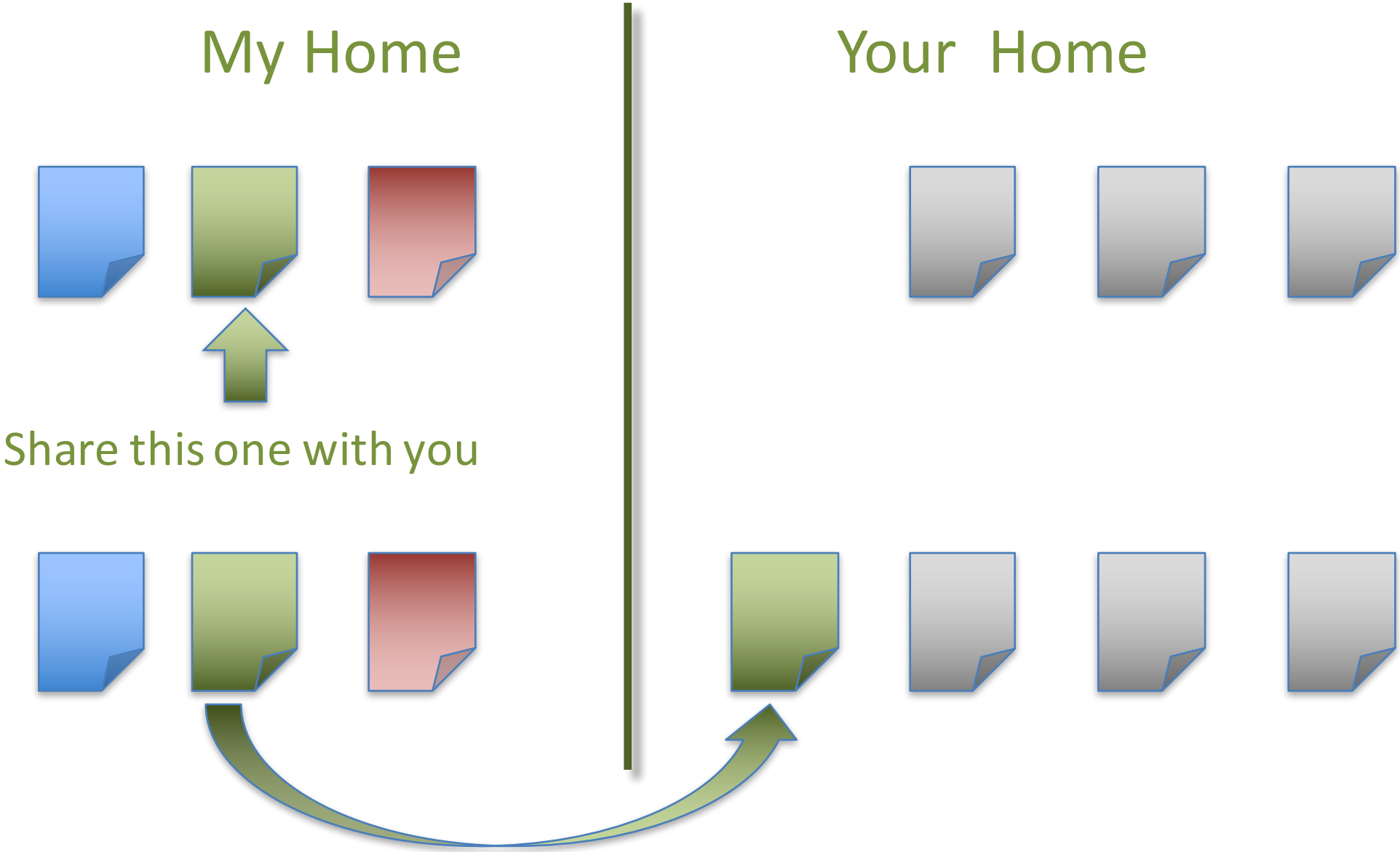
Now, how about the web 2.0 feeling

Sync'n Share ?

The cloud feeling, Sync'n Share



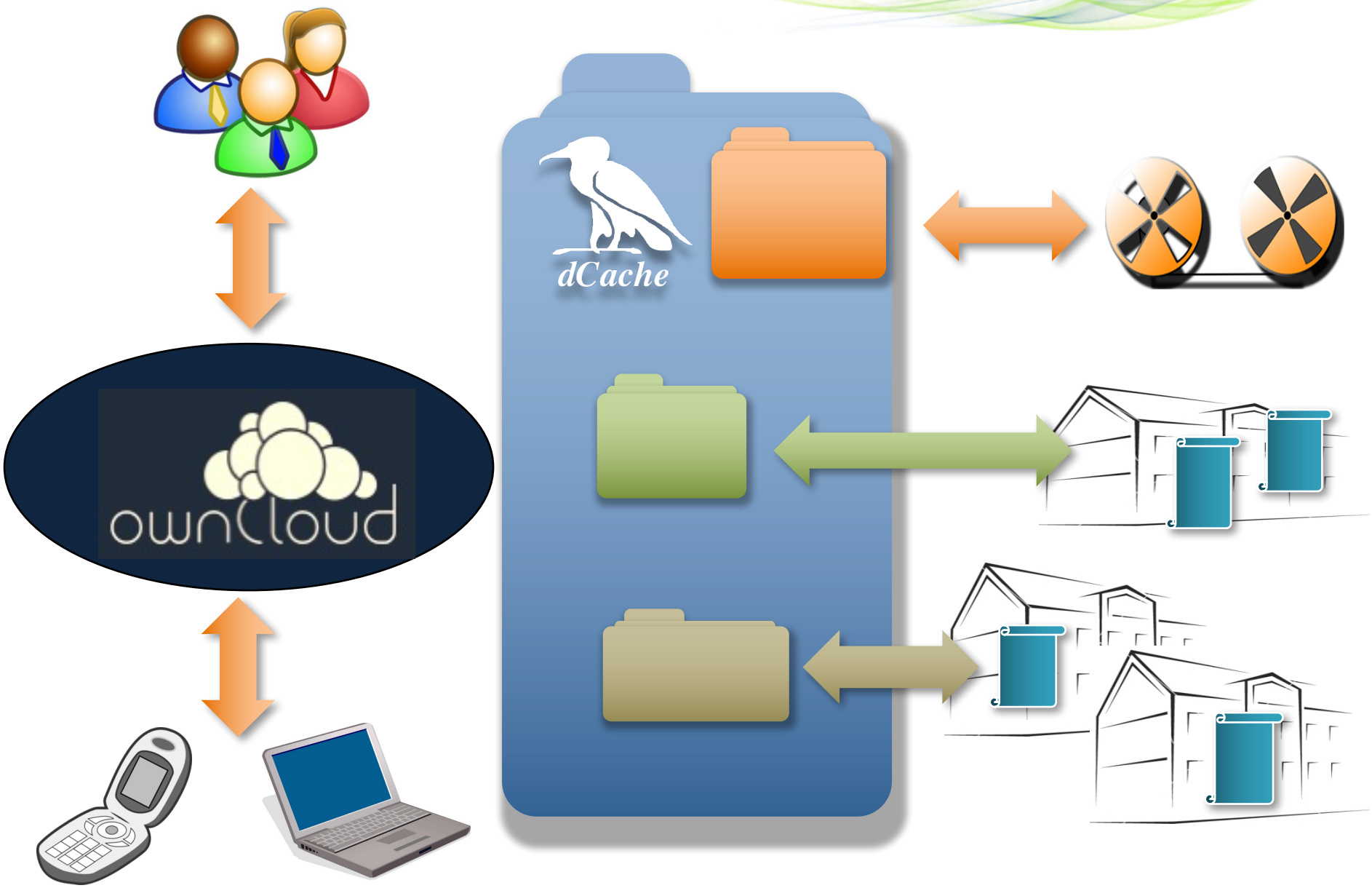
The cloud feeling, Sync'n Share



And as we didn’t want to invent the wheel again, we picked the ownCloud (nextCloud) software do to the trick for us.

So in summary :

The Hybrid System



Scientific Data Lifecycle

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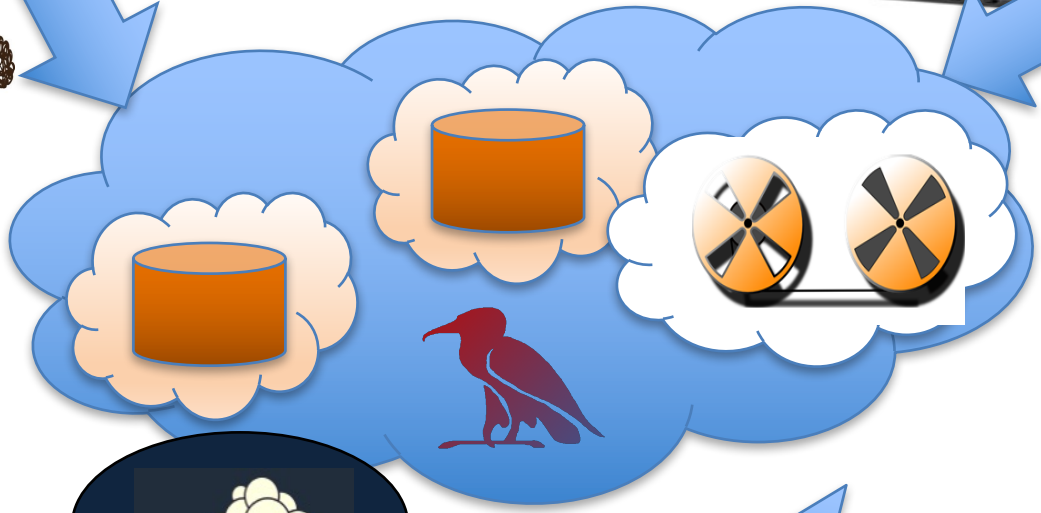
High Speed
Data Ingest



Fast Analysis
NFS 4.1/pNFS

ownCloud

Visualization
& Sharing
by WebDAV, OwnCloud

Wide Area Transfers
(Globus Online, FTS)
by GridFTP

The END

further reading

www.dCache.org