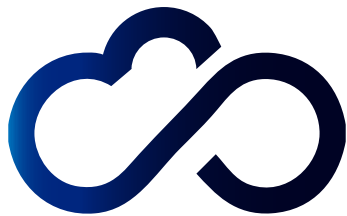


# dCache, sync'n share for Big Data at DESY

Patrick Fuhrmann

On behave of the project team



INDIGO DataCloud



# What is this about ?



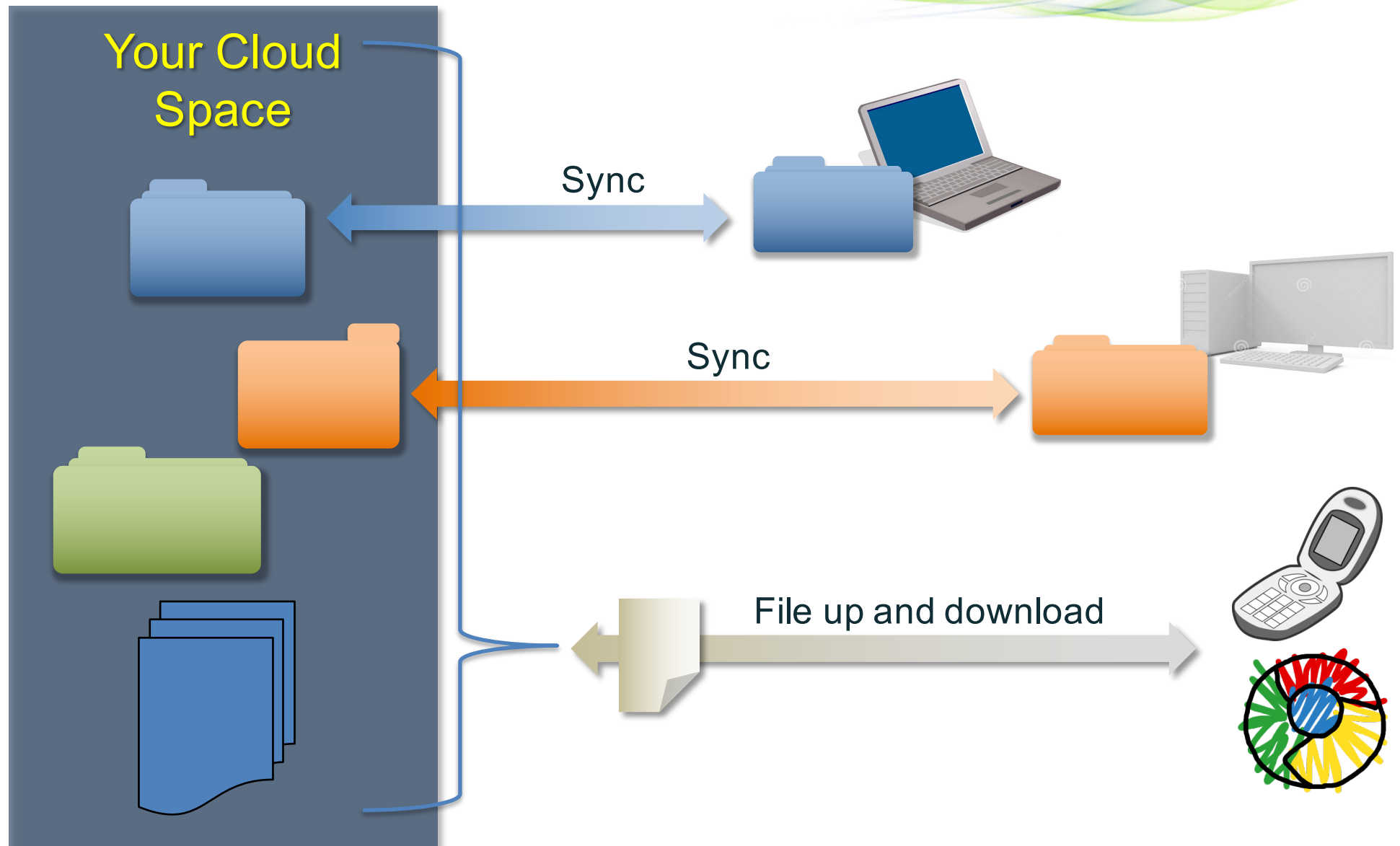
*It's about on how modern scientists  
(people) want to manage, access and  
share their data.*

# Easy access requirements from DESY users



- New model in accessing data
  - Anytime from everywhere
  - From mobile devices
  - Bidirectional sync'ing between your cloud space and your local devices

# How does that look like



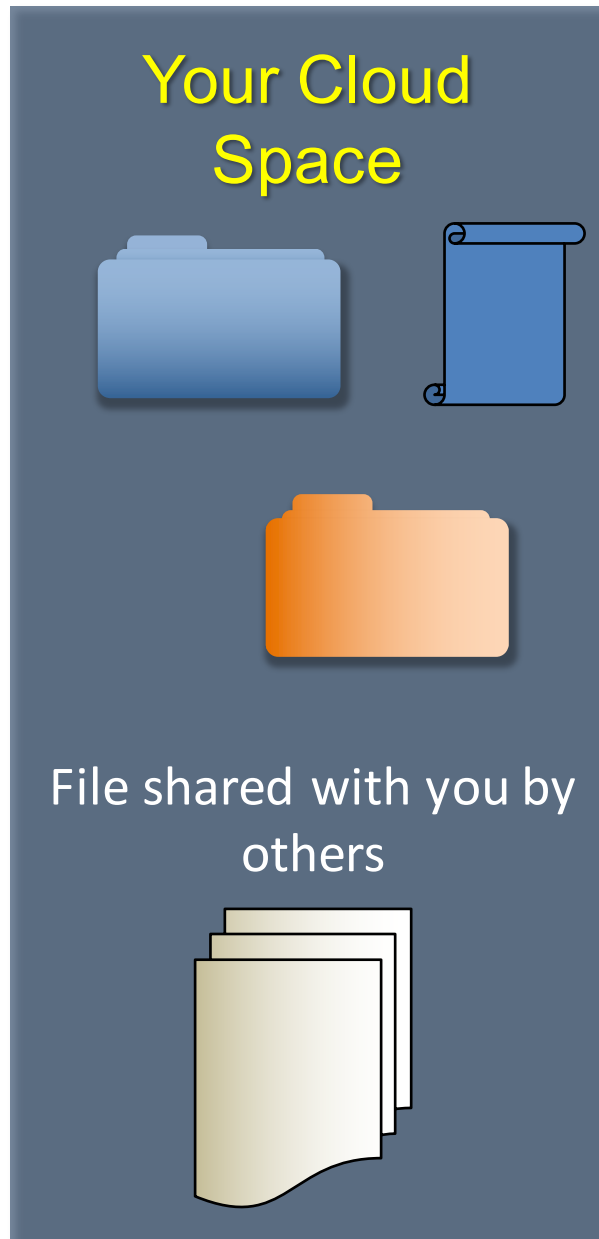


# Sharing requirements from DESY users



- Fine grained sharing with individuals and groups.
- Sharing via intuitive Web 2.0 mechanisms (Apps or Browser)
- Sharing with 'public' with or w/o password protection
- Sharing of free space (upload)
- Expiration of shares

# And the sharing part



Share files/folders with individuals



Share files/folders with 'desy groups'



Share with 'public' with and w/o password  
(Shares can expire)



Share space(s) with others for upload



Others sharing data with you (in your home)

Why not using

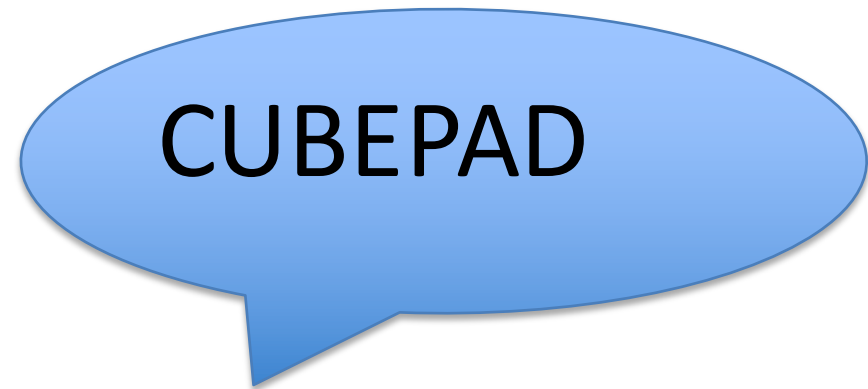


- Because there was this gentleman who decided to leave the US towards Moscow, with a bunch of documents, changing our attitude towards foreign storage services significantly.
- The DESY directorate essentially disallowed storing DESY documents outside of DESY premises.

# Evaluation of possible products



ETC.



- Highly secure group-ware system
- Allows sharing encrypted data

### We went for Own Cloud

- Open Source plus Enterprise version
- Most popular solution:
  - Reduces likelihood for ‘product disappearing’
  - Possibly building a user-community
    - TU-Berlin, FZ-Jülich, TU-Dresden \*\*\*\*
    - CERN, United Nations
- CERN is evaluating a similar approach and we are in contact anyway (WLCG)

# Inevitable RP activities



- Collaboration with HTW Berlin (LSDMA)
- Pre-evaluation of cloud solutions by “InFa” -> Q3/2013
  - Erarbeiten und Umsetzen eines firmeninternen Online-Speicherdienstes in einer Teststellung. (Quirin Buchholz)
- Presenting the concept at HEPIX.
- Information exchange with CERN. (CHEP’13) Oct 13
- Berlin Cloud Event, (mostly OwnCloud and PowerFolder) in Mai 14 (we published first paper)
- Participating the CERN Cloud Event (Nov ‘14) including a presentation of our proposed solution.
- Various papers submitted and accepted at ISGC in Taipei in March and CHEP’15 in Japan.

However, as we do scientific computing and to  
just storing and sharing images,  
there is more to consider.

- Request for *unlimited, indestructible storage*.
- Request for *different quality of services* (SLA), coming with different price tags and controlled by customer.
  - *Data Loss Protection* (non-user introduced), e.g.:
    - One copy.
    - Two copies on independent systems.
    - Two copies in different buildings.
    - Two copies at different sites (e.g. Hamburg and Zeuthen)
    - Some of above plus 'n' tape copies.
  - *Access latency* and max data rate, e.g.:
    - Regular sync and web access.
    - Worker-node access: High throughput
    - Low latency (e.g. on SSD) for HPC.
- User defined *Data Life Cycle*
  - Move data to tape after 'n' months.
  - Remove from random access media after 'm' months.
  - Make public after 'x' month.
  - Remove completely after 'y' months.
- Controlled by Web or API (*Software defined storage*)



## And not to forget

- Access to the same data via different transport mechanisms
  - GridFTP for wide area bulk transfers
  - http/WebDAV for Web applications
  - NFS 4.1/pNFS for low latency, high speed access (e.g. HPC)
- Access with different credentials
  - Username / password
  - X509 Certificates
  - SAML (Single Sign On)
  - Kerberos
  - Macaroons

## Our solution



- Non of the Web 2.0 sync and share software products cover the additional requirements.
- So we went for *dCache* as the actually *storage backend*.
- Which is not really a surprise as we are part of the dCache collaboration.

## Now ... what's a dCache



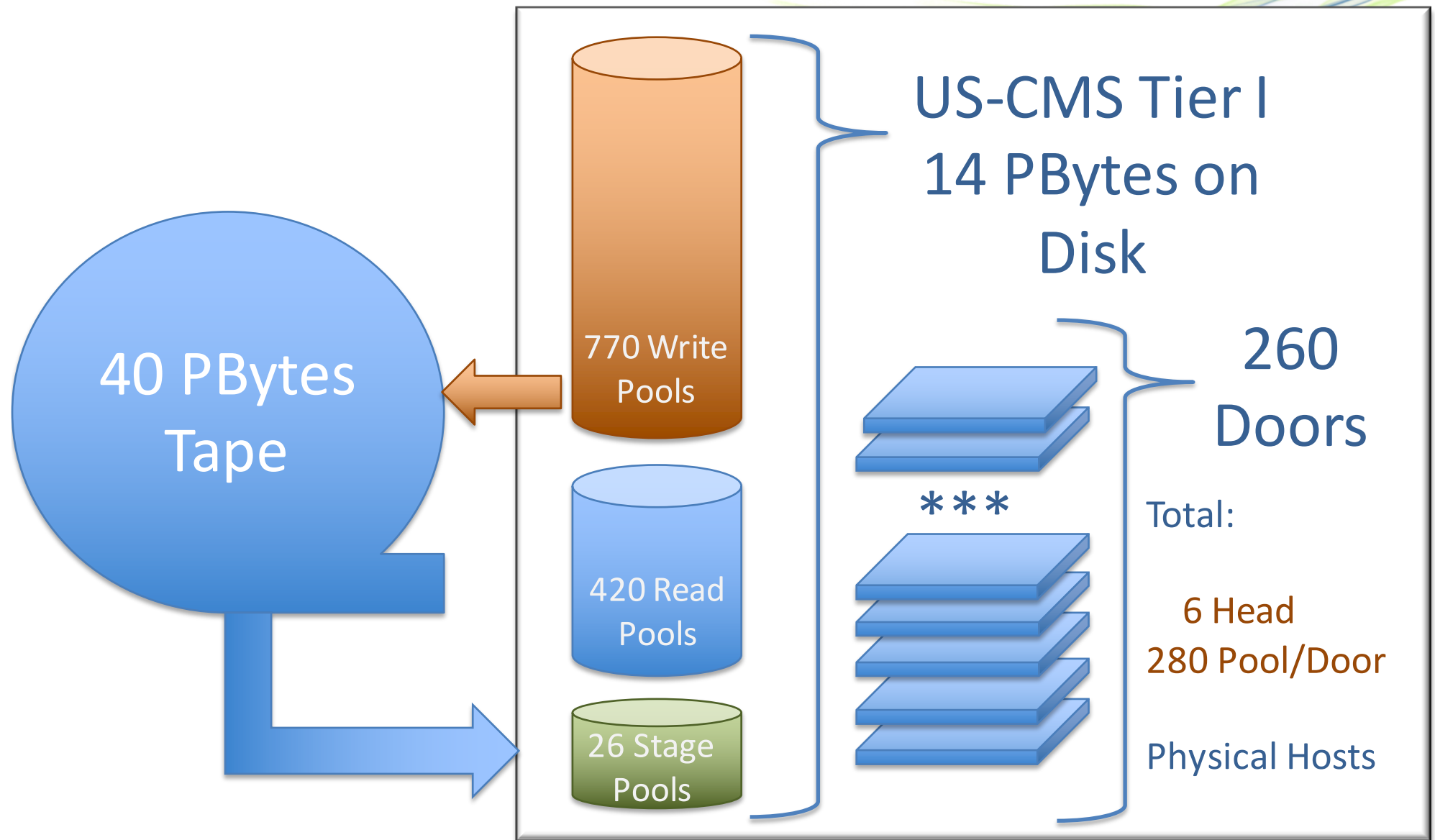
- dCache is a horizontally scaling 'data management system' looking like a file system, providing various data access and data management protocols.
- dCache is operated on about 70 sites around the world.
- Total space approaching 200 Petabytes.
  - We store 50 % of the entire WLCG storage.
- Biggest dCache holds about 50 Petabytes on disk and tape.
- Largest dCache spans 4 countries.
- dCache is provided by dCache.org

## Where do you find dCache's

# Worldwide distribution



Working with possibly the biggest

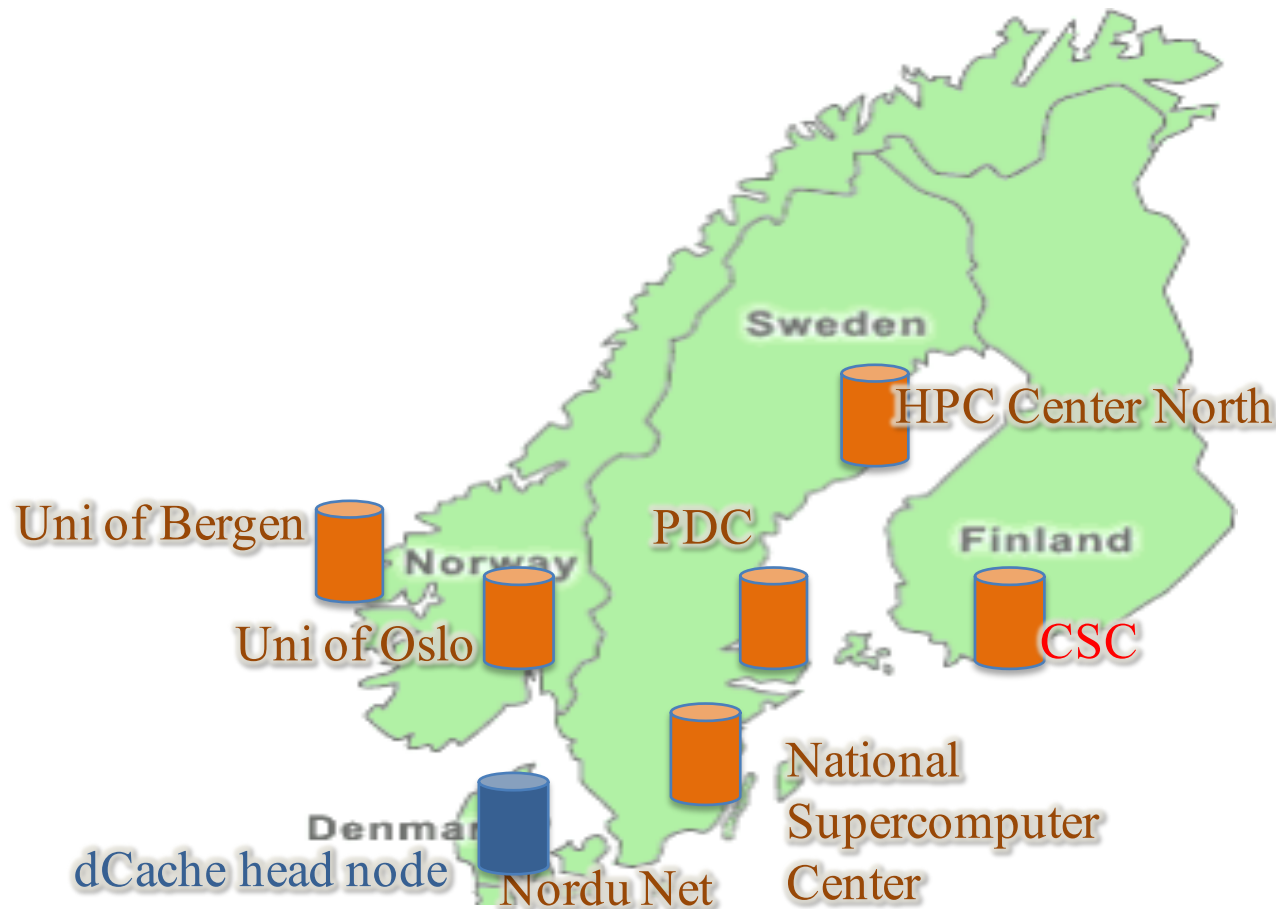


Information provided by Catalin Dumitrescu and Dmitry Litvintsev

To certainly the  
most widespread

4 Countries

One dCache

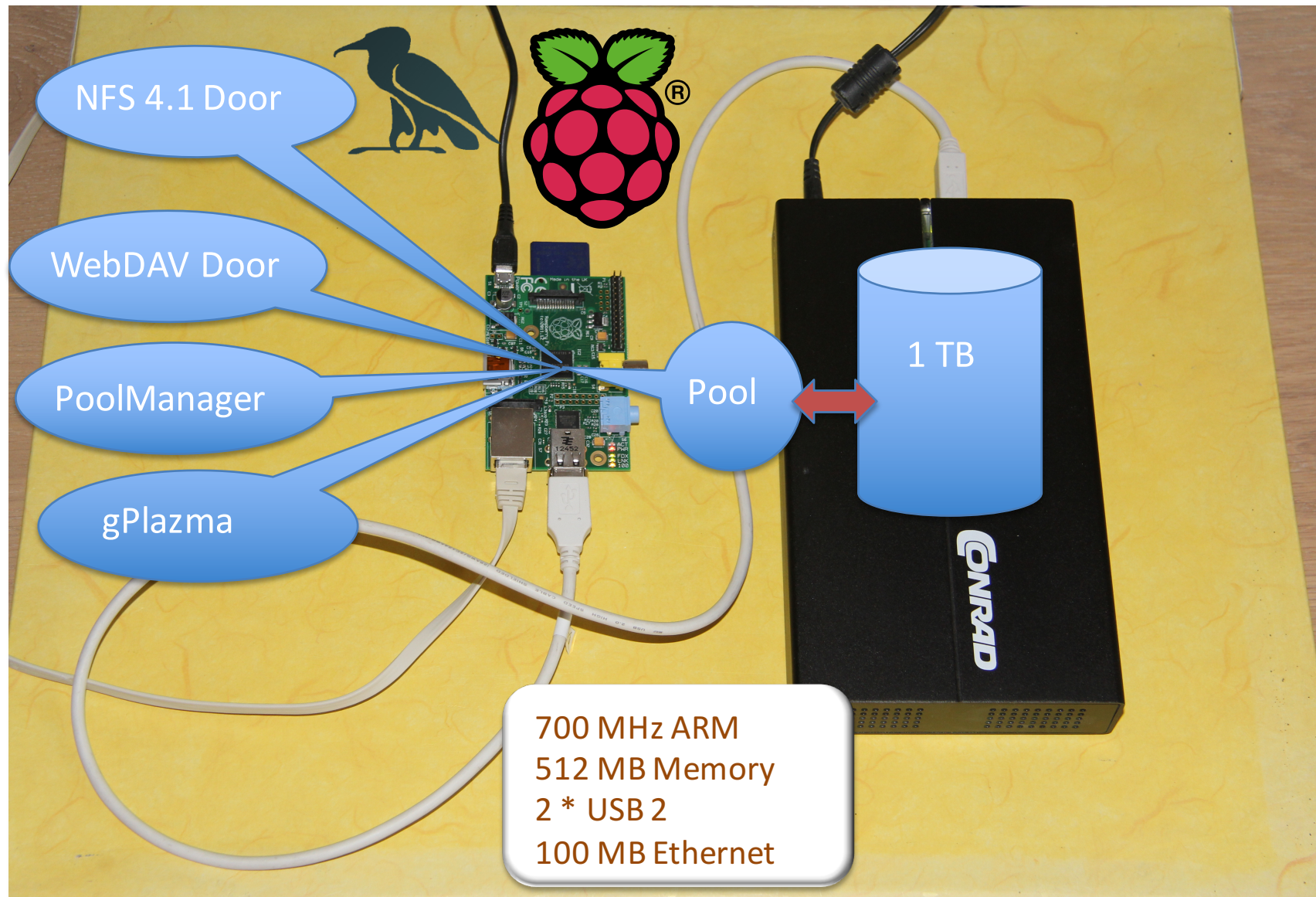


Slide stolen from Mattias Wadenstein, NDGF



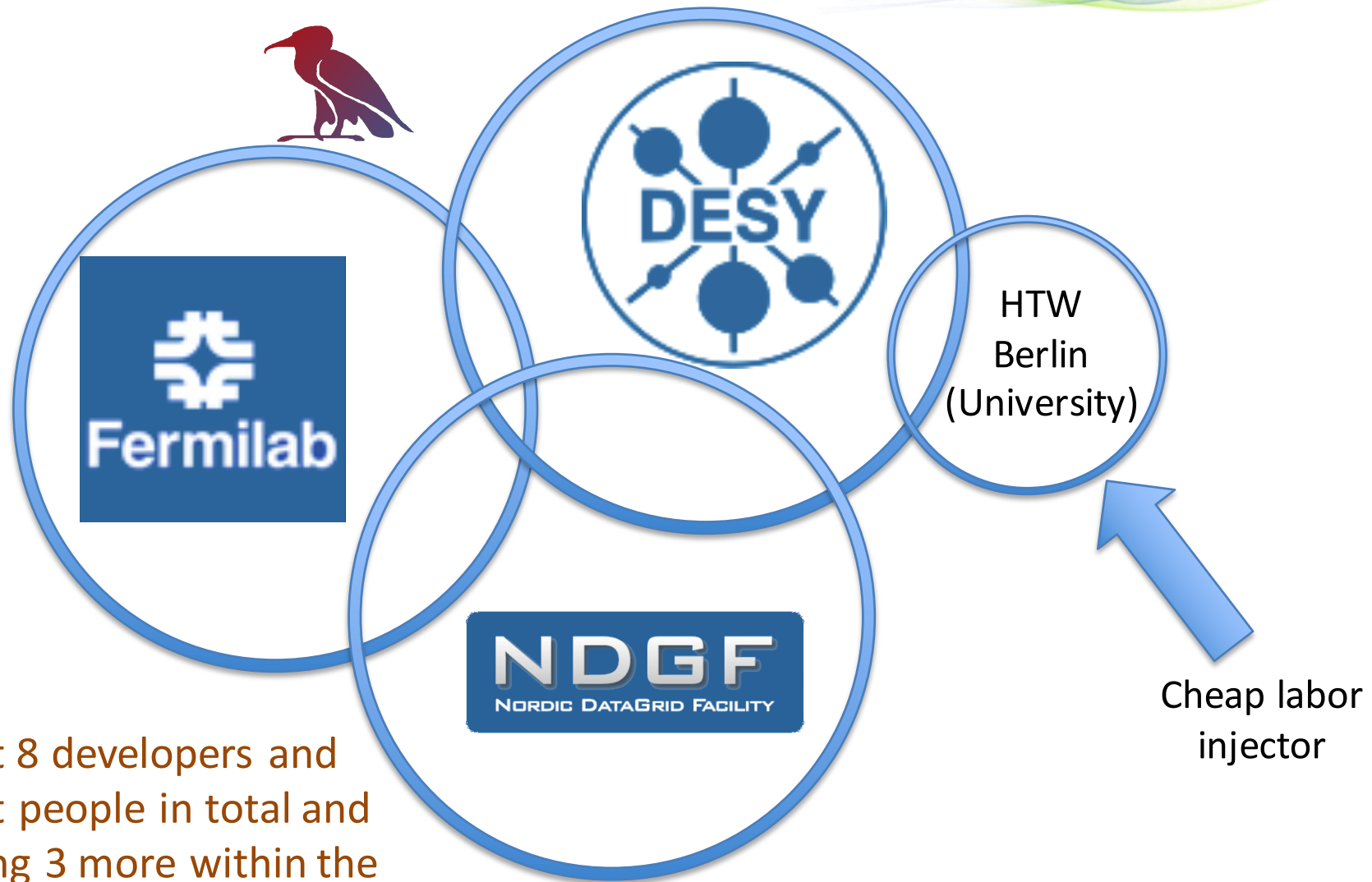
# To very likely the smallest

## One Machine – One Process



## 3 slides on dCache.org

# What's dCache.org



About 8 developers and support people in total and expecting 3 more within the next 3 months.

# dCache.org networking



**EGI**

European Grid Infrastructure

**OSG**

Open Science Grid (US)

**RDA**

Research Data Alliance



**NeiC**

Nordic e-Infrastructure  
Collaboration

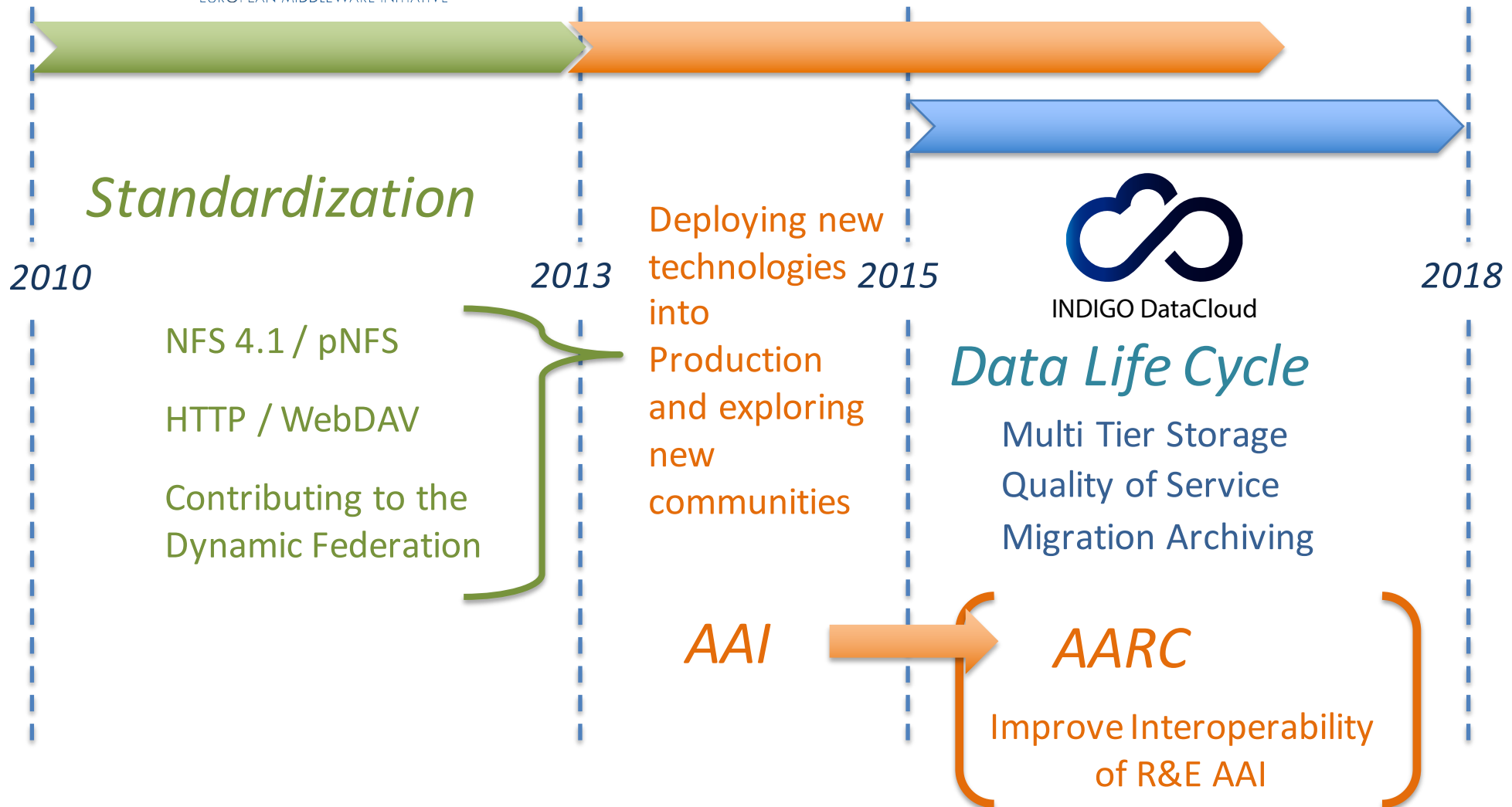
**LSDMA**

Large Scale Data Management  
And Analysis

**WLCG**

World Wide LHC  
Computing Group

# Funding and Objectives





# Technology

# dCache spec for Dummies



NFS/pNFS

httpWebDAV

gridFTP

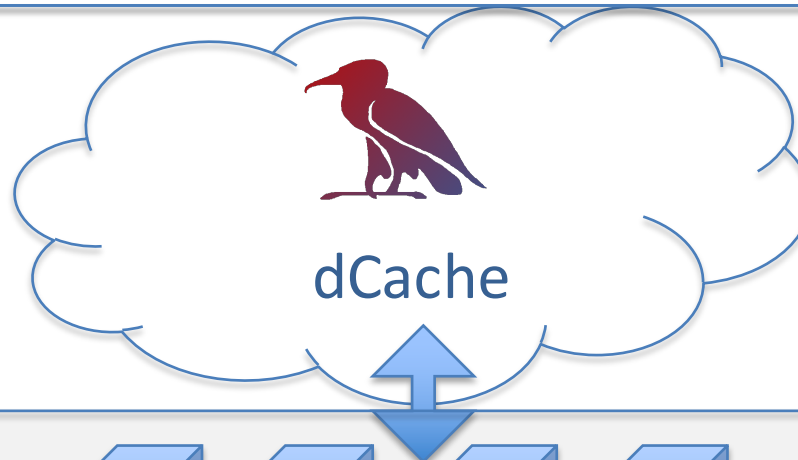
xRootd/dCap



Protocol and Authentication Engines

Virtual File-system Layer

Media Transfer Engine  
and Pool  
Management



Automatic  
and  
Manual  
Media  
transitions

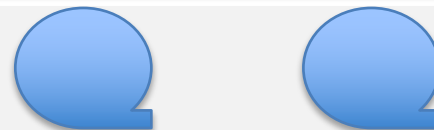
SSDs



Spinning Disks



Tape, Blue Ray ...



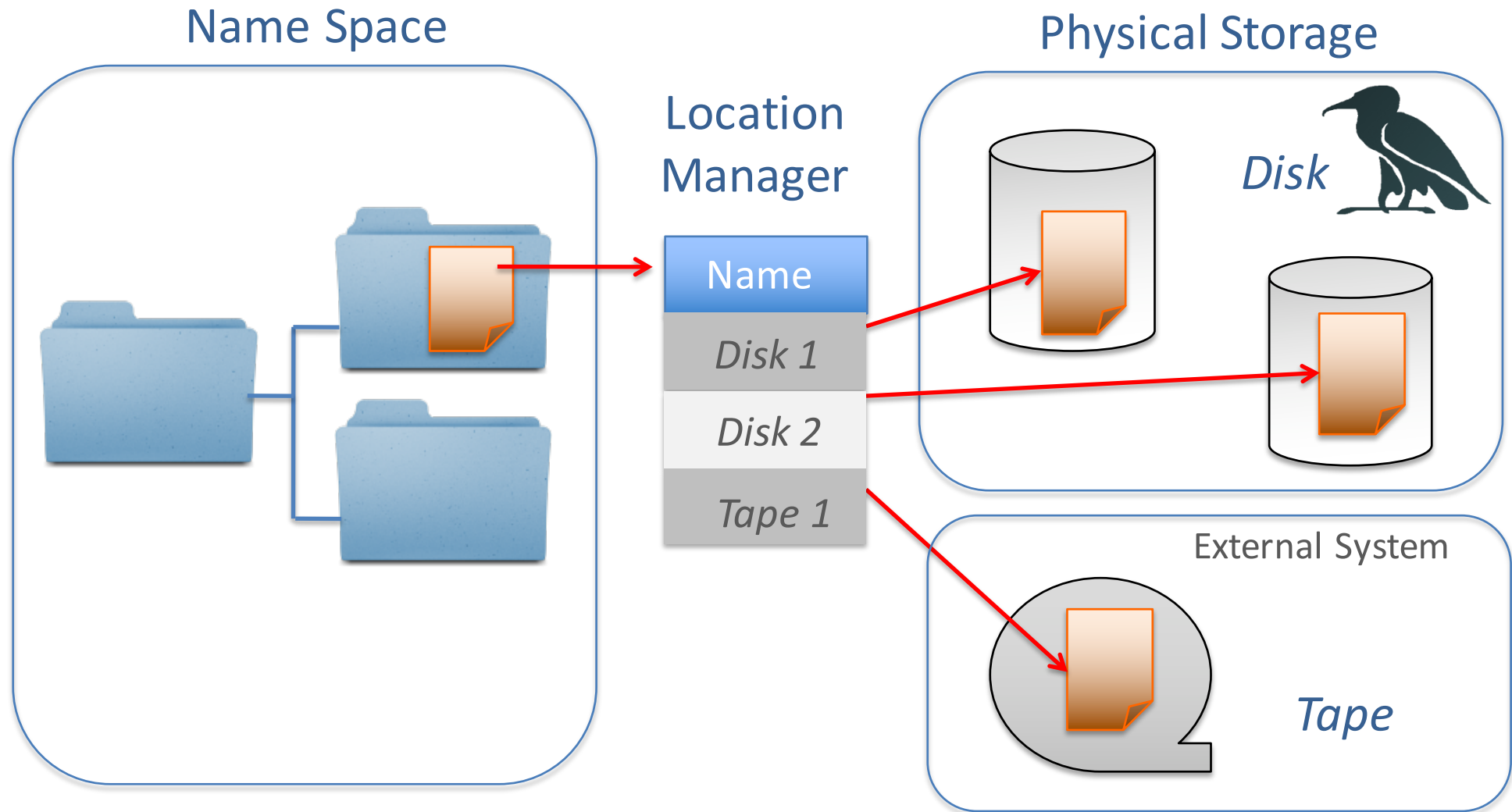
## In other words

- Files are stored as objects on various data back-ends (Hardsdisk, SSD, Tape)
- Back-ends can be highly distributed, even beyond countries.
- The File namespace engine is independent of the data storage itself.
- File object location manager keeps track of copies on the various media.



# Design

## Namespace – Storage separation



- Hot Spot detection
  - Files are copied from ‘hot’ to ‘cold’ pools
- Multi Media Support
  - File location is based on access profile and storage media type/properties
    - Fast streaming from spinning disks
    - Fast random I/O from SSD’s
- Migration Module(s)
  - Files can be manually/automatically moved or copied between pools.
  - Rebalancing of data after adding new (empty) pools.
  - Decommission pools.
- Resilient Manager
  - Keeps max ‘n’ min ‘m’ copies of a file on different machines.
  - System resilient against pool failures.
- Tertiary System connectivity (Tape systems)
  - Data is automatically migrating to tape.
  - Data is restored from tape if no longer on disk

## And what



- Why do we need those features ??
- They are the basis for
  - Software defined Storage
  - Quality of Service Management
    - Defining data access latency
    - Defining data retention policies
  - Data Life Cycle support

# So, what do we get

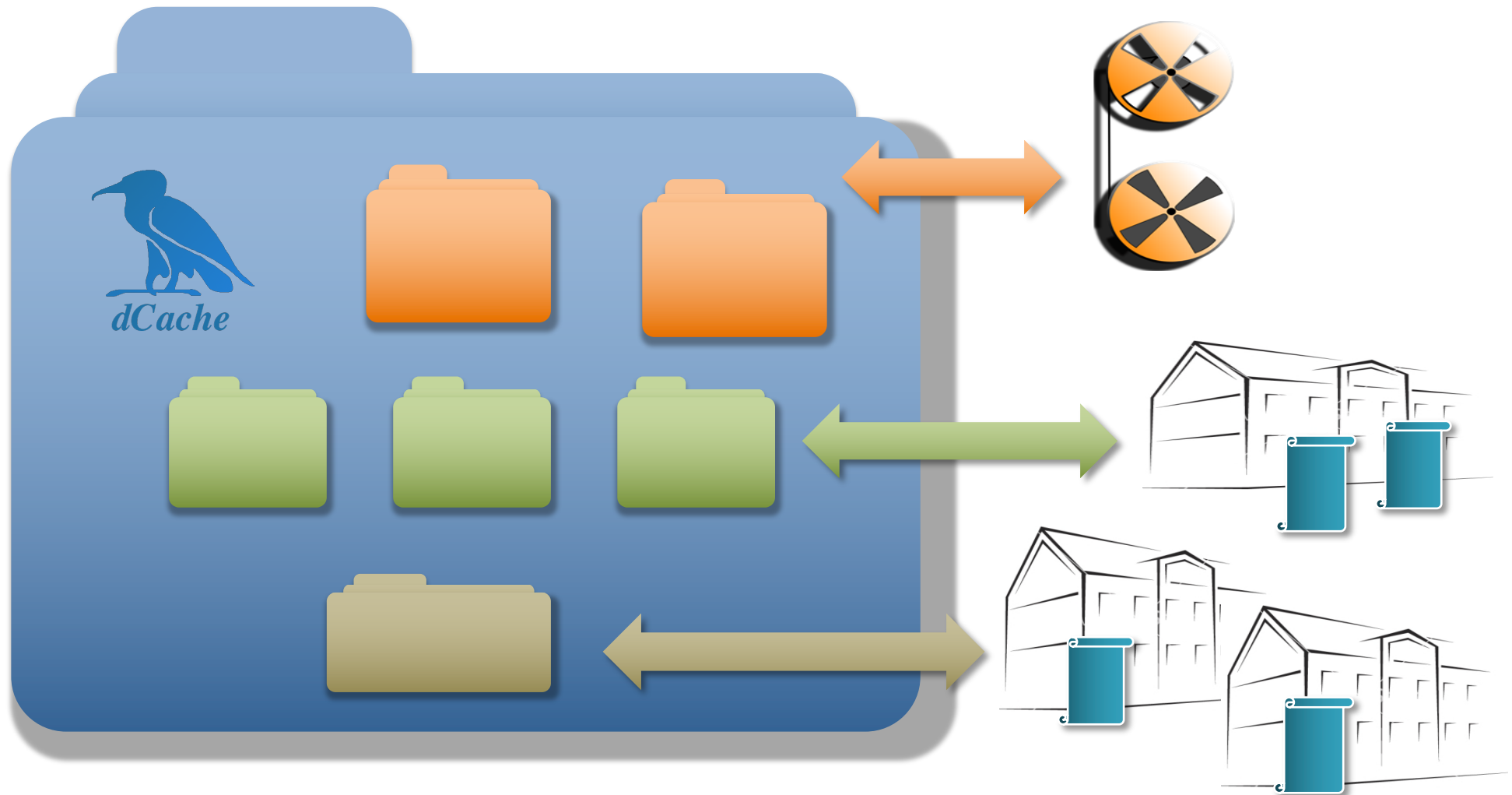


- Through Own Cloud
  - Sync'ing
  - Sharing
- Through dCache
  - Multi protocol support
  - Quality of service (Software defined storage)

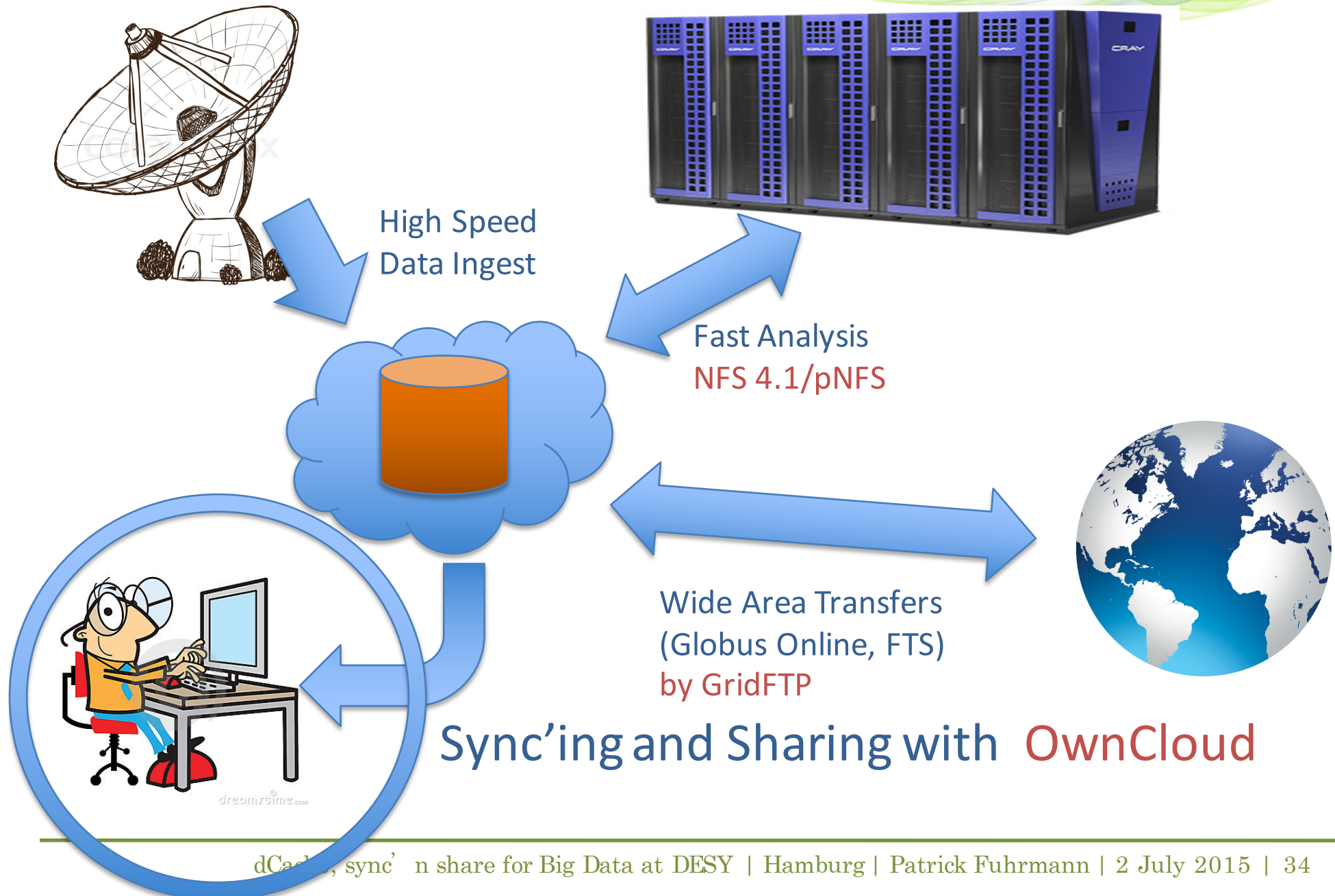
# Quality of service



## My dCache XXL Home

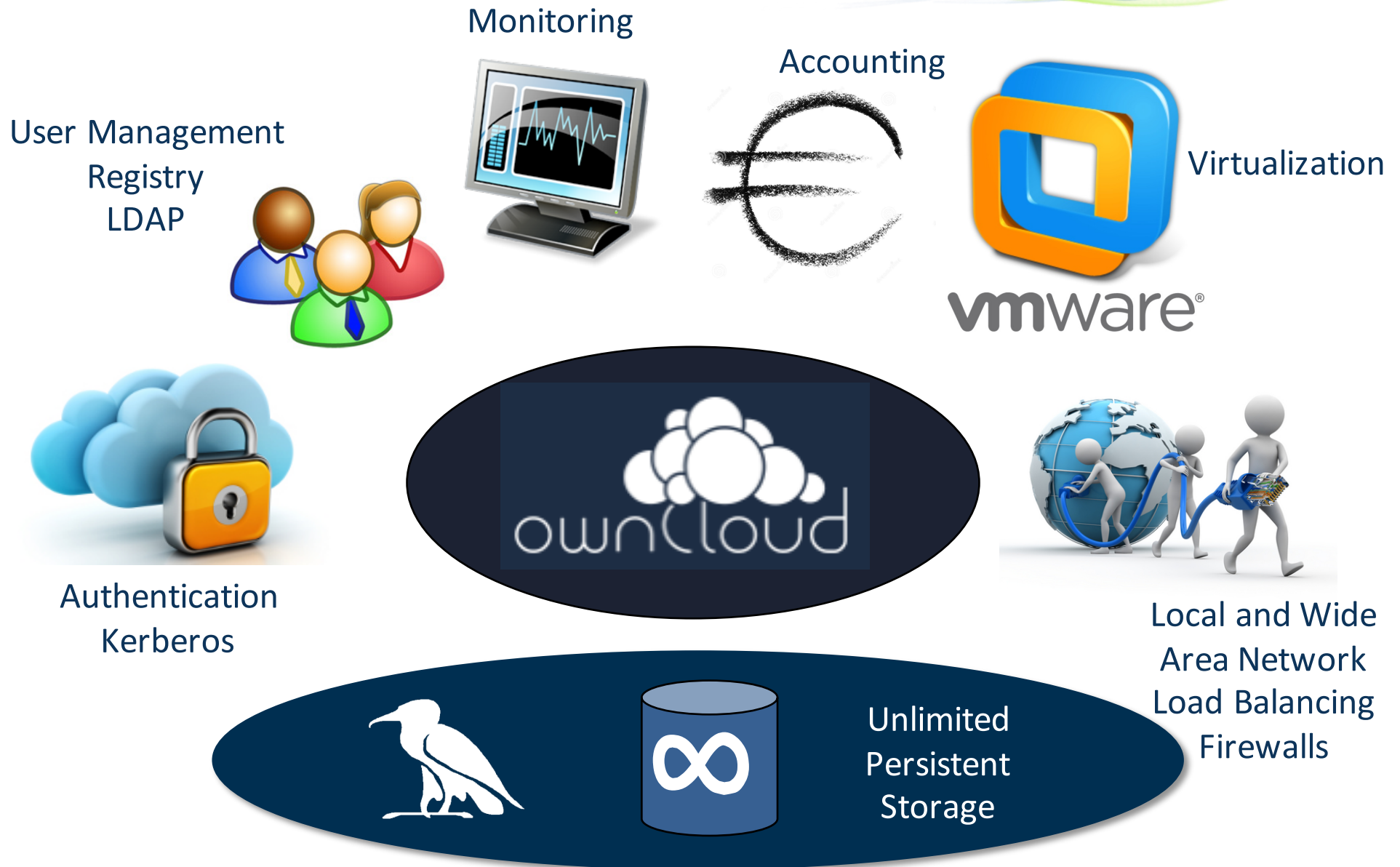


# Scientific Data Flow



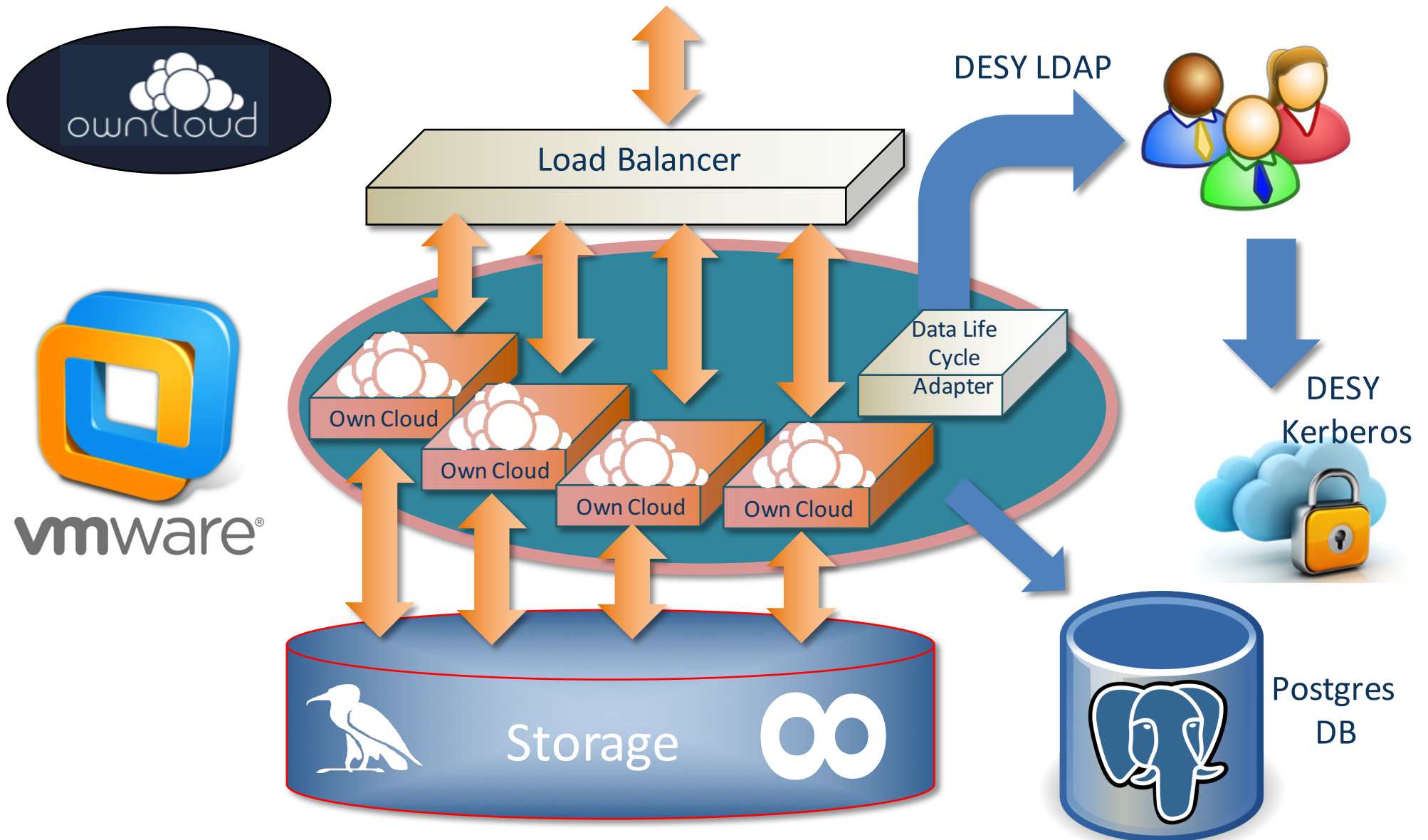
# How is that implemented at DESY ?

# Integration into the DESY infrastructure

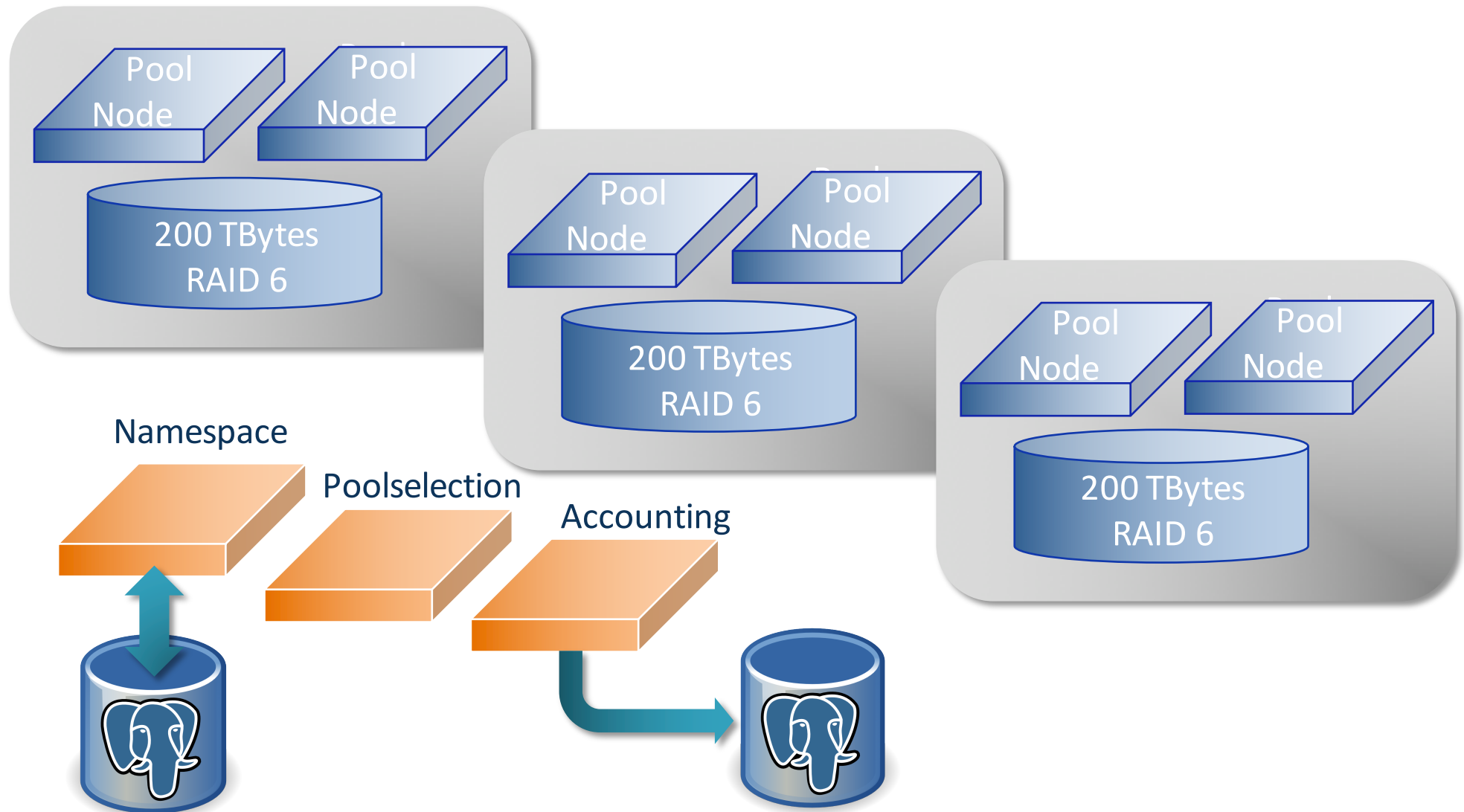




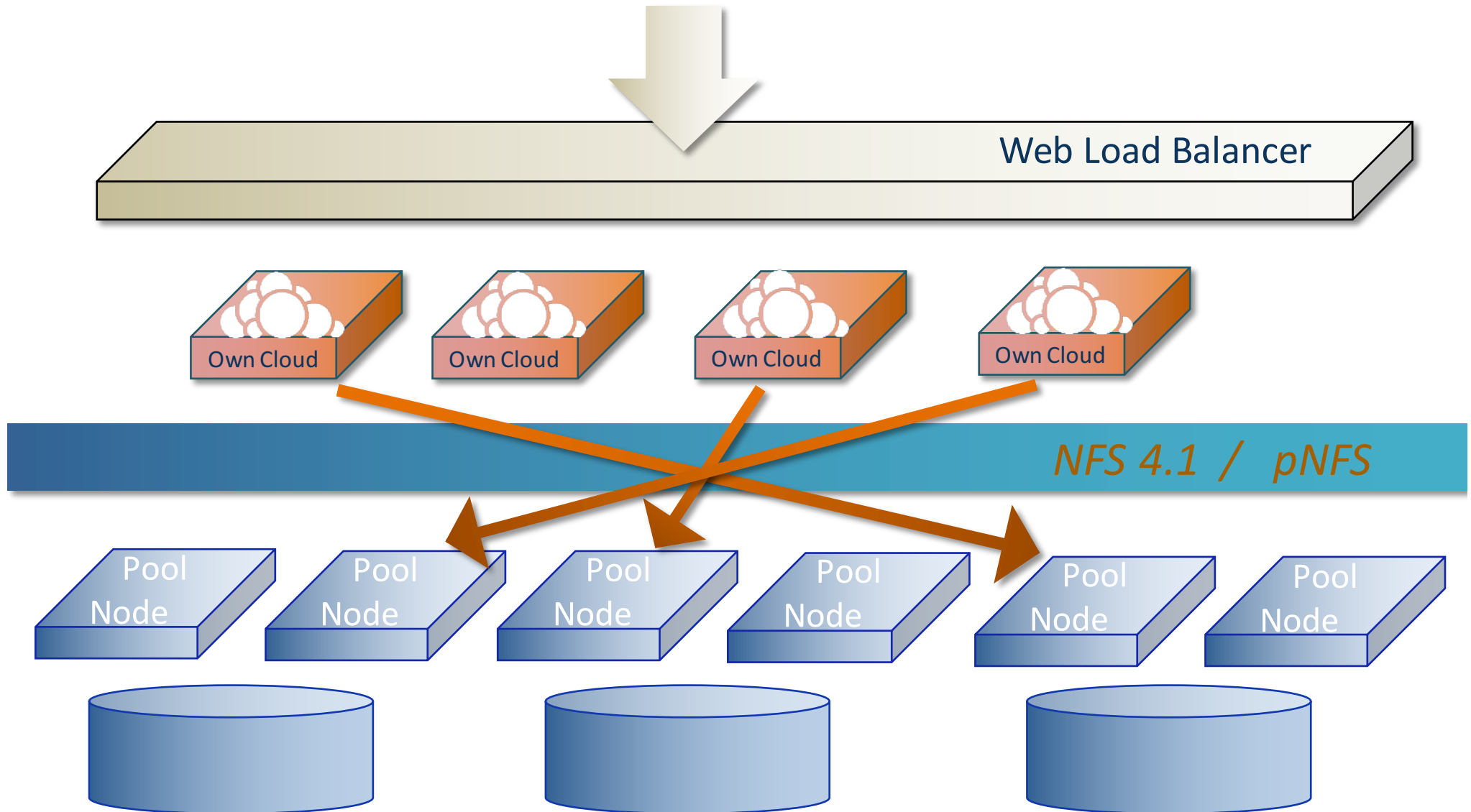
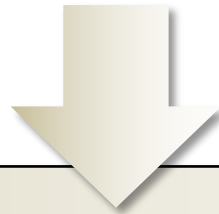
# The Own Cloud Part



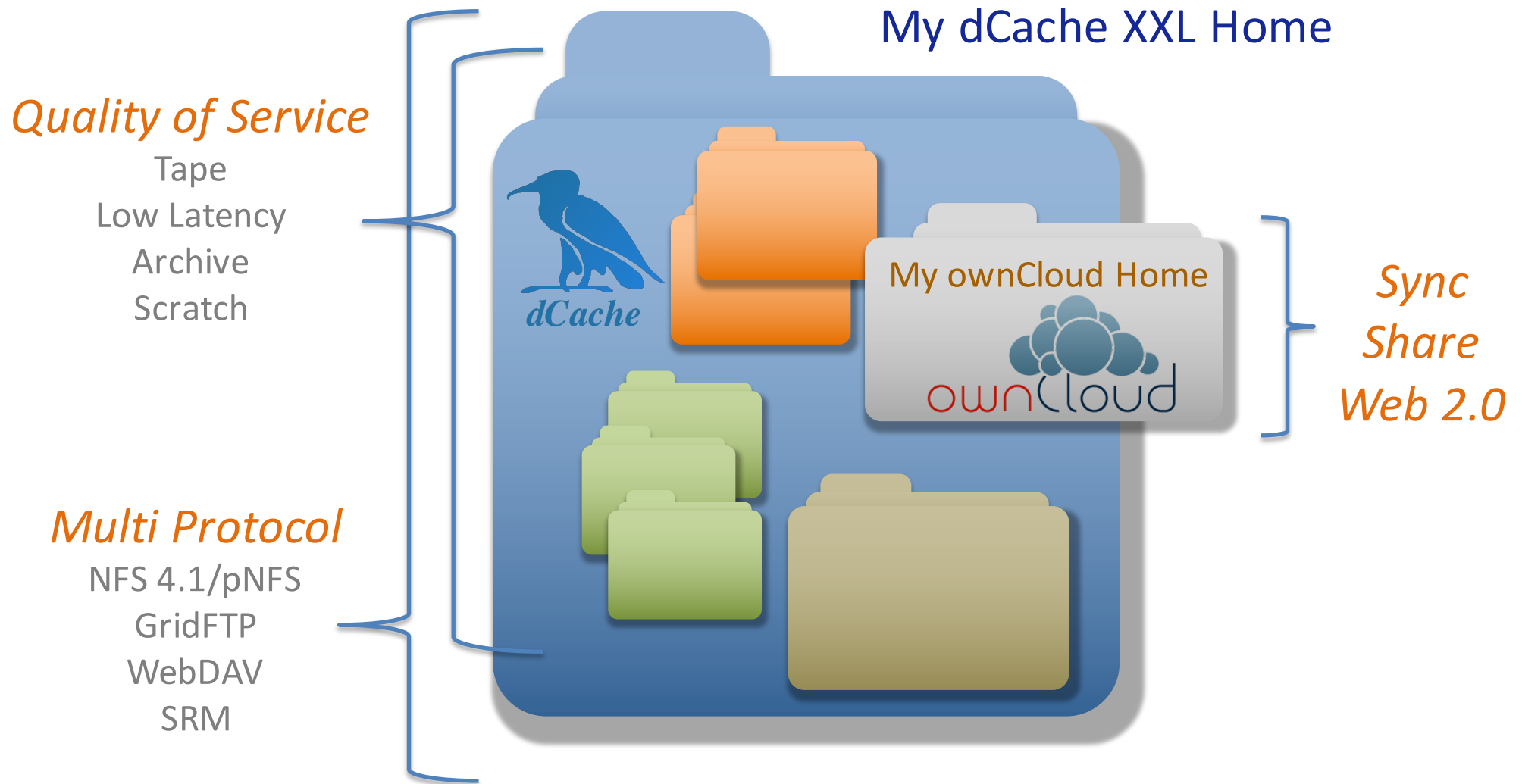
# The dCache part



# The horizontal scaling



# 'HOME' from user perspective



# Summary

- With dCache and OwnCloud, DESY offers a first prototype of a Scientific Cloud service, providing:
  - User specified Storage Properties (QoS)
    - Access Latency, Retention Policies
  - A variety of access protocols
    - Http/WebDAV, GridFTP, SRM, NFS 4.1 (CDMI)
  - Multiple Authentication mechanism
    - X509 Certificates, Kerberos, User/Password (SAML)
  - Sync and share
  - Web Browser access

# The END

further reading  
[www.dCache.org](http://www.dCache.org)

# Response to



- CEPH complements dCache perfectly.
  - Simplifies operating dCache disks.
  - dCache accesses data as object-store anyway already.
- dCache is evaluating a 'two step approach'.
  - Each pools sees it own object space in CEPH
  - All pools have access to the entire space, which is a slight change of dCache pool semantics.
- Would merge CEPH and dCache advantages
  - Multi Tier (Tape, Disk, SSD)
  - Multi protocol support for a common namespace.
    - All protocols see the same namespace
  - All the dCache AAI features
    - Support for X509, Kerberos, username/password