

# Software and Services for Structured Data

## Large Scale Data Management LSDF

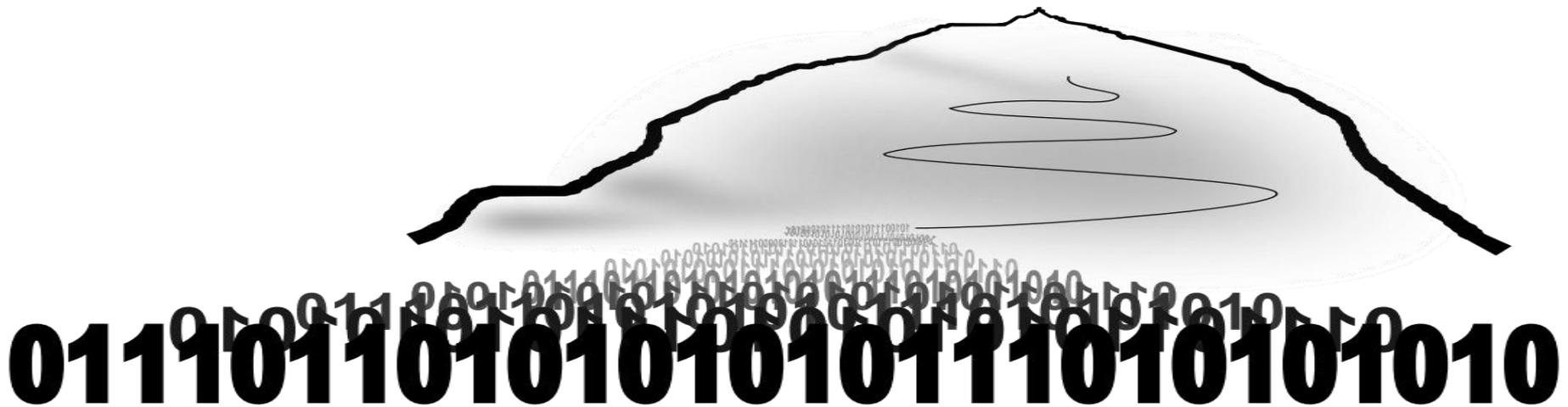
Rainer Stotzka,

D. Tonne, T. Jejkal, V. Hartmann, H. Pašić, T. Schmidt, F. Rindone, S. Ochsenreither, M. Weber  
W. Mexner, M. Hagelstein, P. Vagovic, T. dos Santos Rolo, T. Farago  
J. van Wezel, M. Hardt, A. Garcia, R. Kupsch, S. Bourov, A. Streit

Institute for Data Processing and Electronics

Institute for Synchrotron Radiation

Steinbuch Centre for Computing



# Data @ Karlsruhe

**GridKA**  
Grid storage  
element  
10 PB online

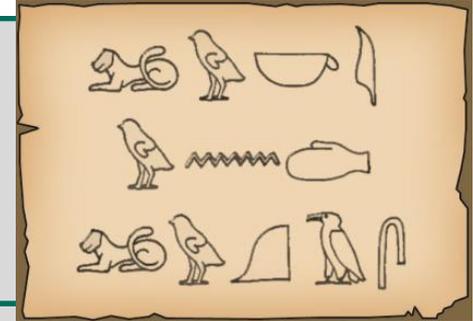
**State  
data storage**  
Baden-  
Württemberg

**Large Scale  
Data Facility**  
2 PB storage  
and archives

# LSDF objectives

## Storage

- Dedicated for science data
- ExaByte scale data
- To archive data, long term sustainability (10 yrs. – ?)



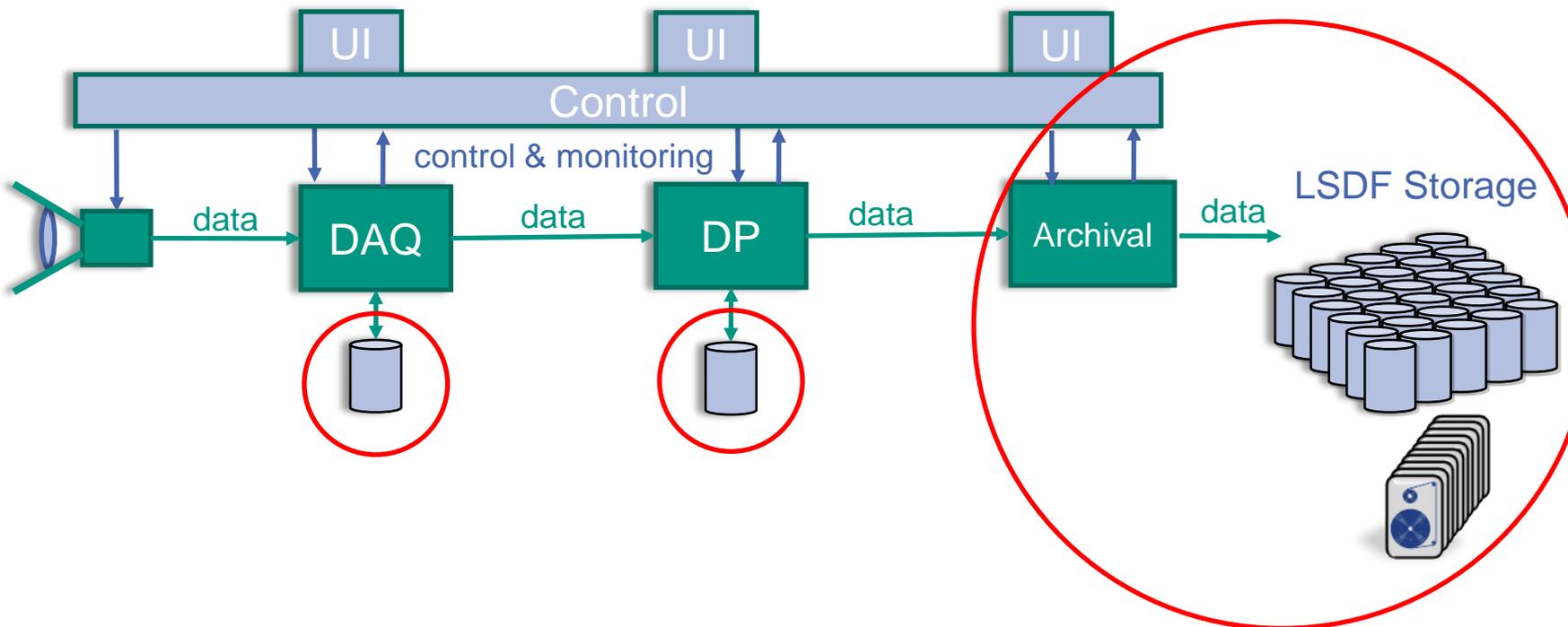
## Interactivity

- To enable scientists to gain better scientific results by providing
  - Data intensive analysis
  - Added value services for data intensive processing
- To provide high performance access, high throughput
- “Barrier free” access (easy-to-use)
- Sustainability and interoperability

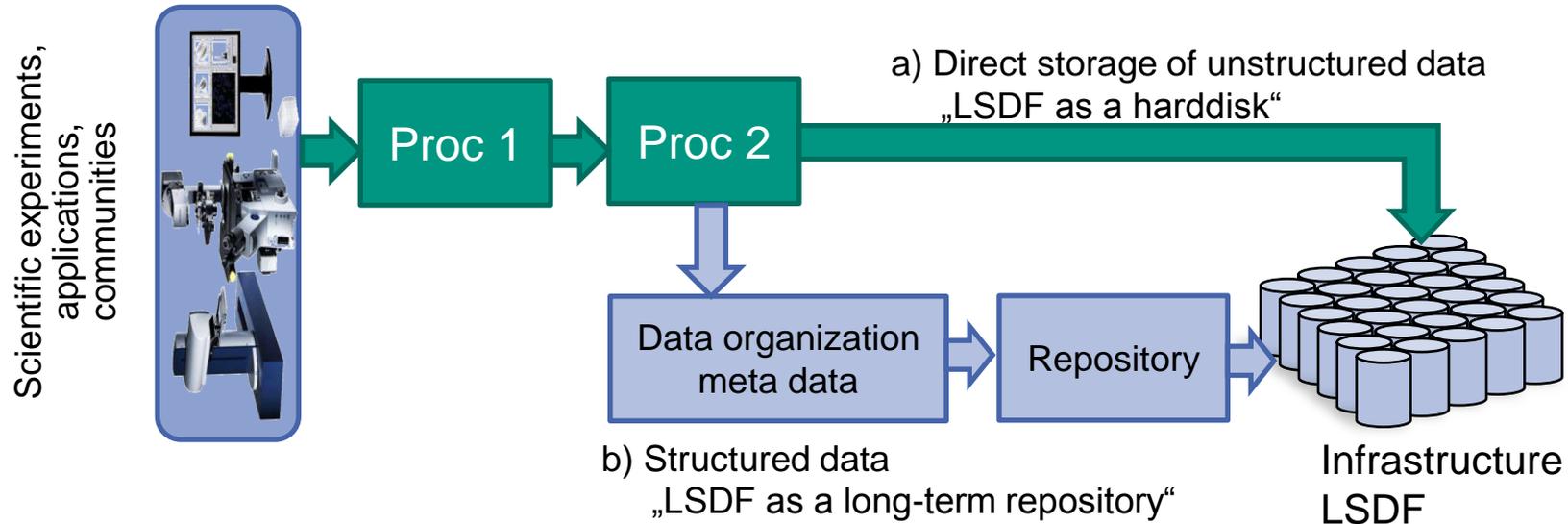
### “Guidelines”:

- |  |   |
|--|---|
| • PARADE White Paper (2009):               | Strategy for a European Data Infrastructure                     |
| • ESFRI Data Management Task Force (2009): | e-IRG Report on Data Management                                 |
| • OAIS (2002):                             | Reference Model for an Open Archival Information System         |
| • High Level Experts Group (2010):         | Riding the Wave – European Commission Report on Scientific Data |
| • HLEG-SD (2010?):                         | Note on Data Services infrastructure                            |
| • Microsoft Research (2009):               | The Fourth Paradigm: Data-Intensive Scientific Discovery        |

# Focus: ANKA Image BLs



# Unstructured vs. Structured Data



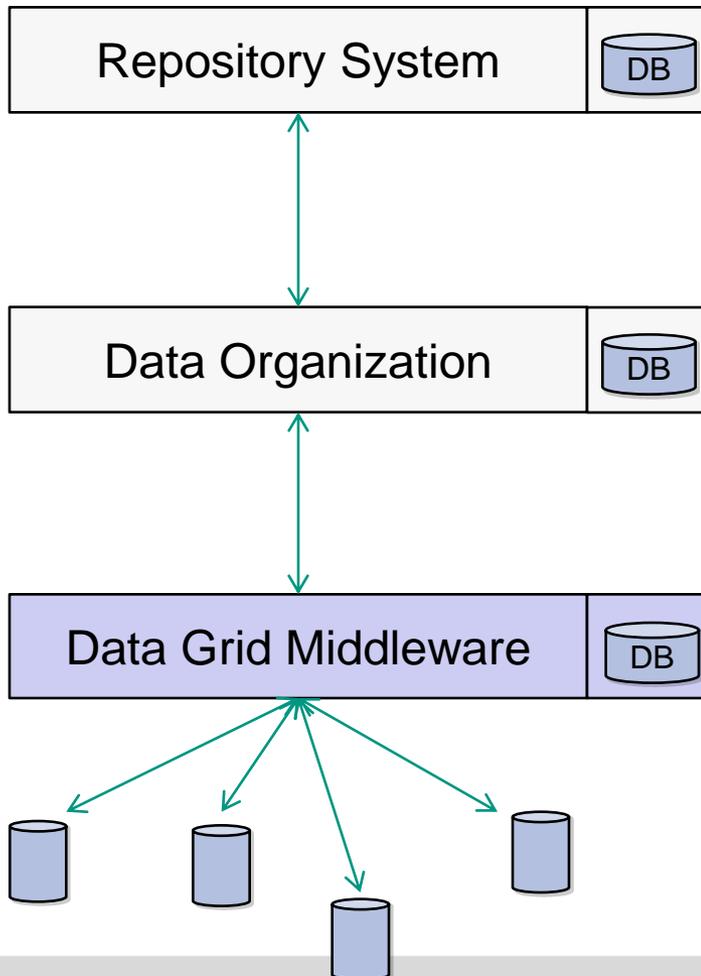
## a) Unstructured data

- Harddisk
- “Content“ and “Structure“ unknown to provider
- User is responsible for data life cycle and curation
- Backup, seldom bit preservation
- Local access

## b) Structured data

- Data is archived with known meta data and data organization
- Clear separation between storage organization, data organization and project meta data
- Provider is responsible for life cycle, preservation and curation
- World-wide access

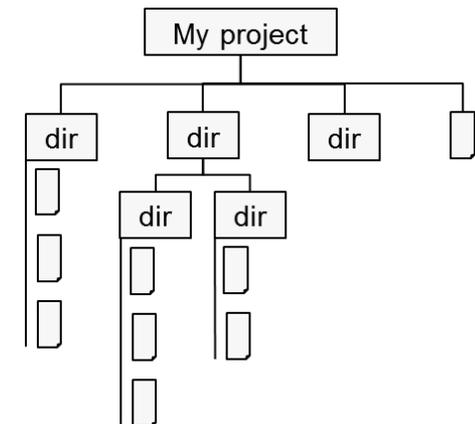
# Separation



## Scientific meta data

(KIT DataBrowser, Fedora repository, dSpace,...)

## Content structure and file meta data



## Virtualization of storage resources

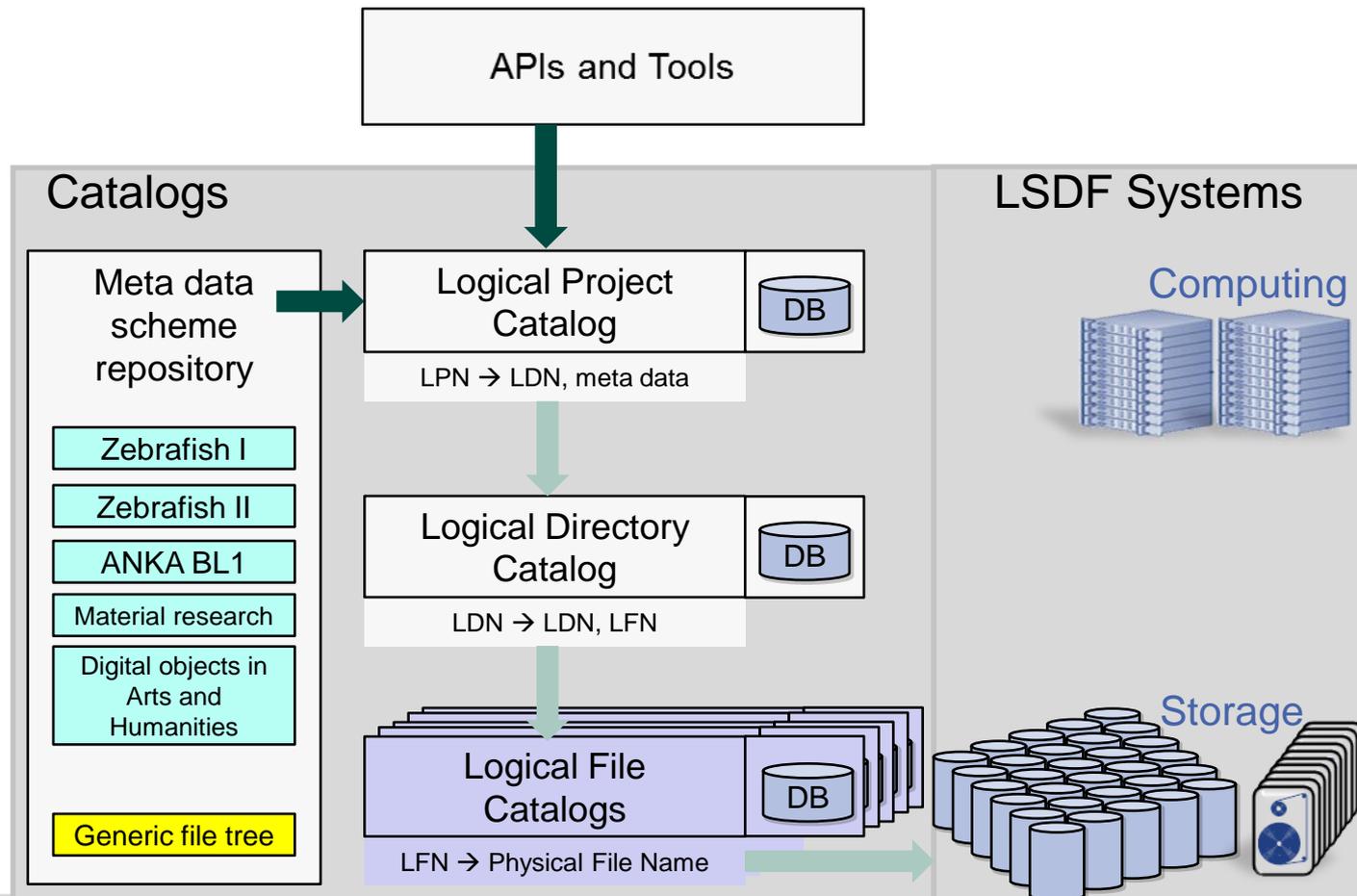
(dCache, iRODS, Merritt, Active Circle...)

## Storage resources, heterogeneous, distributed

# DataBrowser for structured data archives

## Hierarchical Catalog System for Structured Data (Repository system)

- Sustainable
- Easily extensible
- Independent of data formats
- Enhanced performance: distribution of access
- Safety by redundancy
- Easy-to-use?



# KIT DataBrowser

Repository system for large scale data

- High-throughput for large data sets

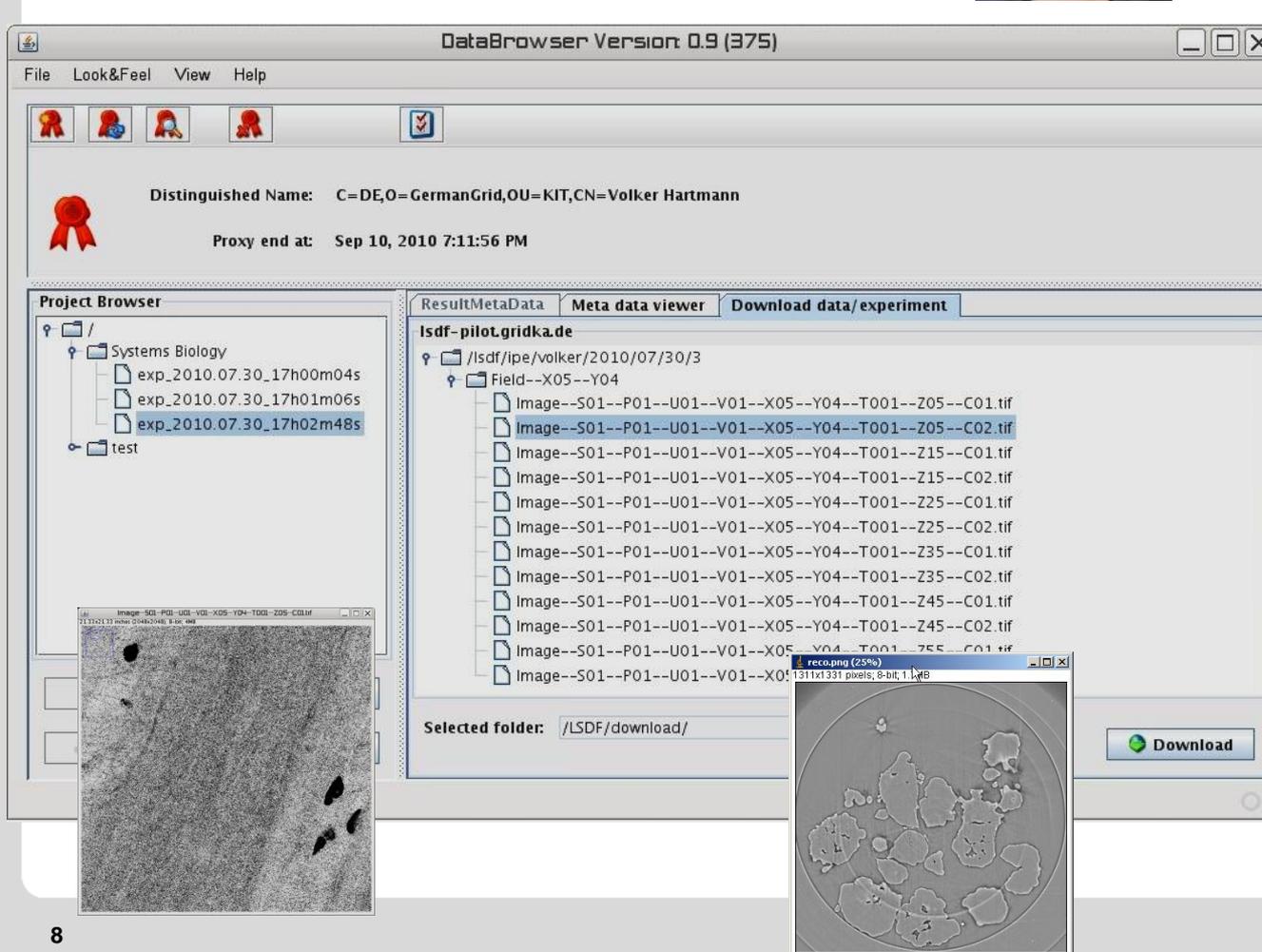


- Easy-to-use
- Extensible
- World-wide accessible
- Stable



## Functions:

- Data management
- Queries in meta data cataloges
- Up-/Download
- Control of data analysis + vis. workflows

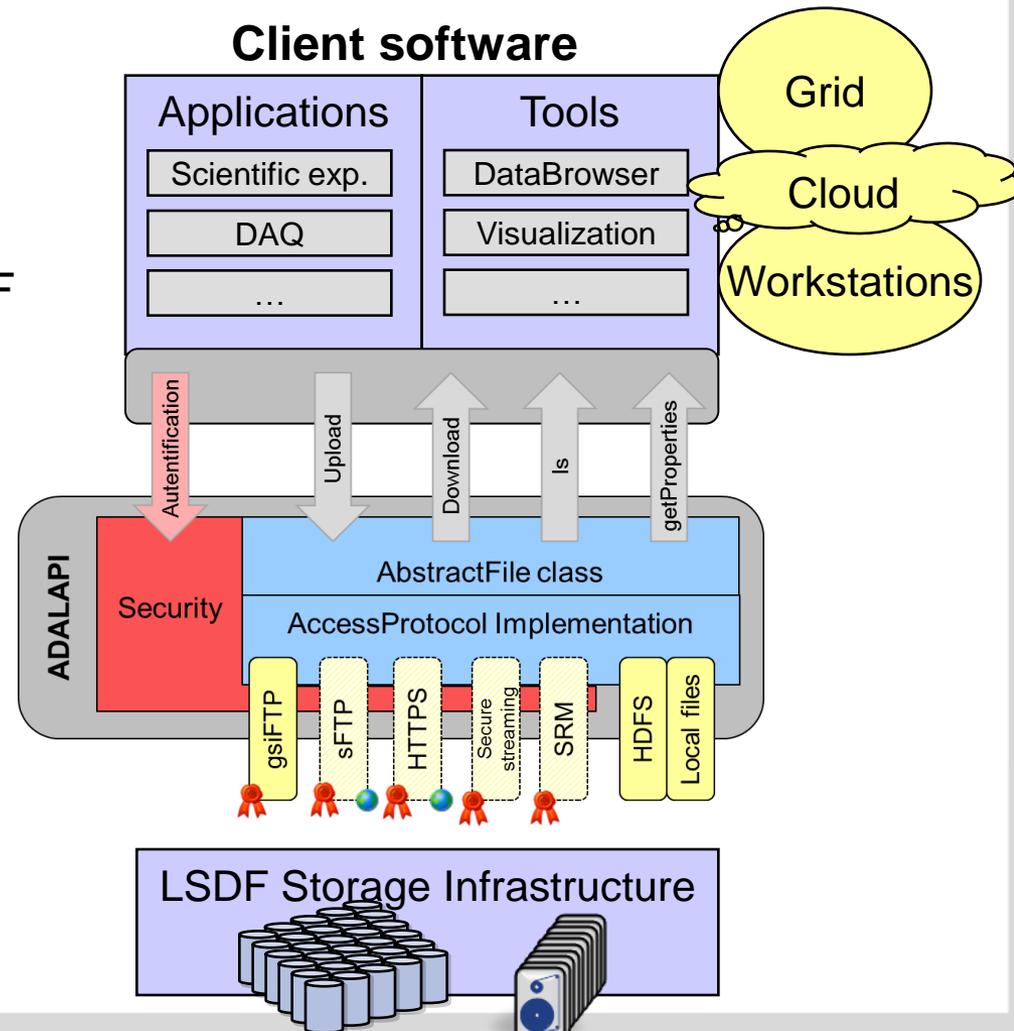


The screenshot shows the DataBrowser web interface. At the top, it displays 'DataBrowser Version: 0.9 (375)'. Below this is a navigation menu with 'File', 'Look&Feel', 'View', and 'Help'. A ribbon icon is visible on the left. The main content area shows a 'Distinguished Name: C=DE,O=GermanGrid,OU=KIT,CN=Volker Hartmann' and 'Proxy end at: Sep 10, 2010 7:11:56 PM'. The interface is divided into several panels: a 'Project Browser' on the left showing a tree structure of folders like 'Systems Biology' and 'exp\_2010.07.30\_17h00m04s'; a central 'ResultMeta data' panel with tabs for 'Meta data viewer' and 'Download data/experiment', displaying a list of image files with names like 'Image--S01--P01--U01--V01--X05--Y04--T001--Z05--C01.tif'; a 'Selected folder: /LSDF/download/' field; and a 'Download' button. Two image thumbnails are shown at the bottom: one of a grayscale micrograph and another of a segmented image labeled 'reco.png (25%)'.

# Data Transfer

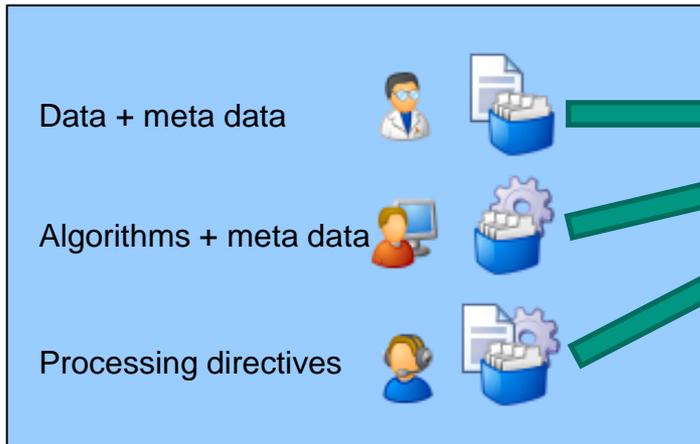
## Abstract Data Access Layer Application Programming Interface (ADALAPI)

- Java class library
- Seamless application access to LSDF
- Independent of transfer protocol and location
- Protocols and filesystems
  - local files,
  - gsiftp
  - sftp
  - http(s)
  - hdfs
  - iRODS
  - REST (Fedora)
- Authentifikation:  
X.509 certificates, user/passwd
- Performance  
up to 210 MB/s, 10 GE, gsiftp

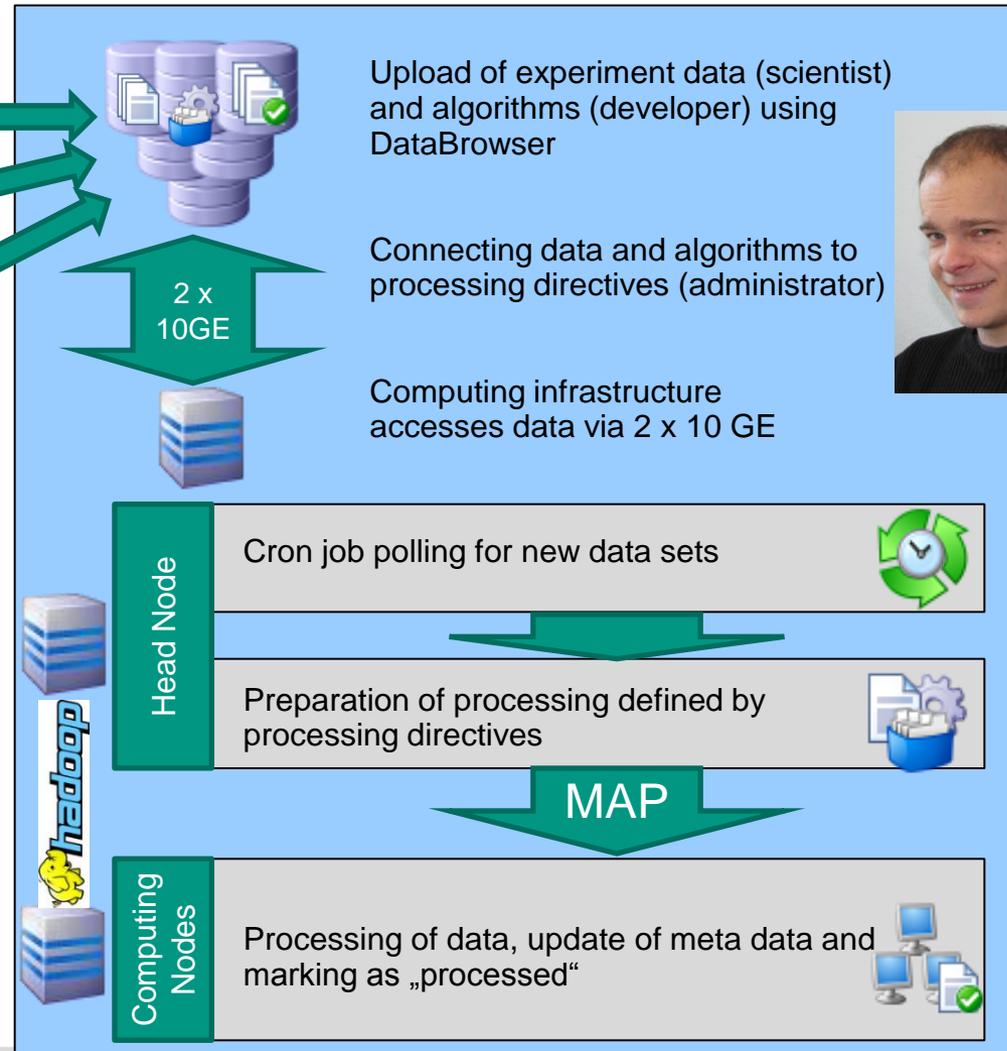


# Generic Workflow Execution Framework

## DataBrowser



## LSDF + hadoop



- Environment für arbitrary meta data driven workflows
  - Development
  - Deployment
  - Ingest
- Automatic processing based on “processing directives”
- Monitoring and error processing
- Algorithm database

# DataBrowser und Lif2Raw Workflow



Upload Experiment

Experiment folder: /LSDF/download/simpleLif

Device: Leica microscope (LIF & XML) ▾

Creator: C=DE,O=GermanGrid,OU=KIT,CN=Volker Hartmann ▾

Date: Apr 11, 2011   Execute Workflow 

Note: You can put some free text notes here...

Workflows  
└ Lif2Raw (v2.0)

Project: Volker ▾ Protocol: sFTP ▾

sFTP  
gsiFTP

# DataBrowser und Lif2Raw Workflow Monitoring



DataBrowser Version: 1.0 (890)

File Look&Feel View Help

Distinguished Name: C=DE,O=GermanGrid,OU=KIT,CN=Volker Hartmann  
Proxy end at: Apr 11, 2011 7:49:19 PM

**Project Browser**

- /
- Ariel
- Danah
- Francesca
- Halil
- Thomas
- Volker
- Volker\_schedule
- schedule
- workflow
  - exp\_2011.03.21\_11h07m16s
  - exp\_2011.03.21\_14h32m05s
  - exp\_2011.03.21\_16h10m39s

Add... Clone... Import... Remove

**Download data/experiment** **Meta data viewer** **ResultMetaData**

Workflows

- #2: Lif2Raw v1.0

**General Workflow Information**

Workflow #2: Lif2Raw v1.0

Status: ● Succeeded at Mar 21, 2011 1:17:24 PM

Output URL: `sftp://ipelsdf1.lsfdf.kit.edu:2222/lsdfdf/katrin/2011/03/21/1/Lif2Raw_1.0_0`

**Workflow Output**

ipelsdf1.lsfdf.kit.edu

- /lsdfdf/katrin/2011/03/21/1/Lif2Raw\_1.0\_0
  - Lif2Raw\_1.0.txt
  - RAW
  - TIFF
  - stderr.log
  - stdout.log
  - tmp
  - workingDir

```
Starting wrapper script execution...
Using runtime 'java' (Version 1.0)
Using script command line 'ImageJ.jar'
Using script parameters '/lsdfdf/katrin/2011/03/21/1/simpleLif/ /lsdfdf/katrin/2011/03/21/1/Lif2Raw_1.0_0/'
Changing current directory to working directory '/lsdfdf/katrin/2011/03/21/1/Lif2Raw_1.0_0/workingDir'
Starting execution at: Mo 21. Mär 13:16:54 CET 2011
Received exit code 0 at: Mo 21. Mär 13:17:02 CET 2011
```

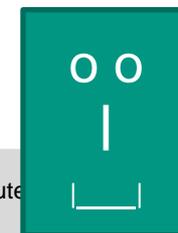
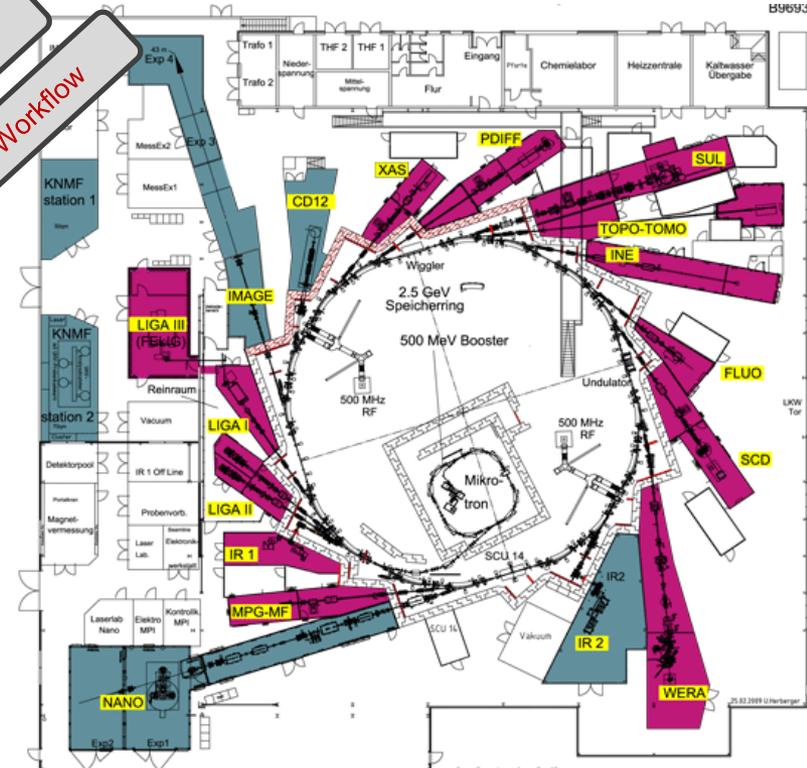
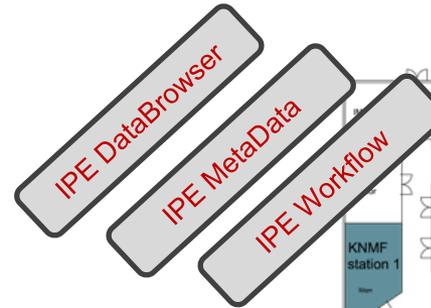
Close

# Data Management for ANKA

## PhD Student Halil Pašić



- Design of the data life cycle management for image BLs
  - Transparent connection to LSDF
  - LSDF archiving (0,5 PB/a)
- 
- Definition and Implementation of data formats and APIs for BL data access  
→ in cooperation with Eugen Wintersberger (DESY) + Tomas Farago (ANKA)





**PDP 2012**

20th Euromicro International Conference on Parallel, Distributed  
and Network-based Processing

15-17 February 2012 in Garching, Germany

[www.pdp2012.org](http://www.pdp2012.org)

### Topics

- Parallel Computing
- Distributed and Network-based Computing
- **Data Intensive** Computing
- Models and Tools
- Systems and Architectures
- Advanced Algorithms and Applications

### Program Chair

Rainer Stotzka, KIT, Karlsruhe, Germany  
Michael Schiffers, LMU, Munich, Germany  
Yiannis Cotronis, UA, Athens, Greece

### Special Sessions

- Cloud Computing for Compute and Data Intensive Applications
- On-chip Parallel and Network-based Systems
- Energy-aware Systems
- GPU Computing and Hybrid Computing
- Security in Networked and Distributed Systems
- Next Generation of Web Computing
- Modeling, Simulation, and Optimization of Peer-to-peer environments
- Grid, Parallel and Distributed Bio-informatics Applications
- Cross-Fertilisation of Parallel and Metaheuristics Techniques
- **Parallel and distributed storage** systems

### Important Dates

Papers due:	July 25, 2011
Acceptance notification:	October 10, 2011
Camera-ready versions:	November 11, 2011