Advancing data management and analysis in different scientific disciplines

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CHEP 2016

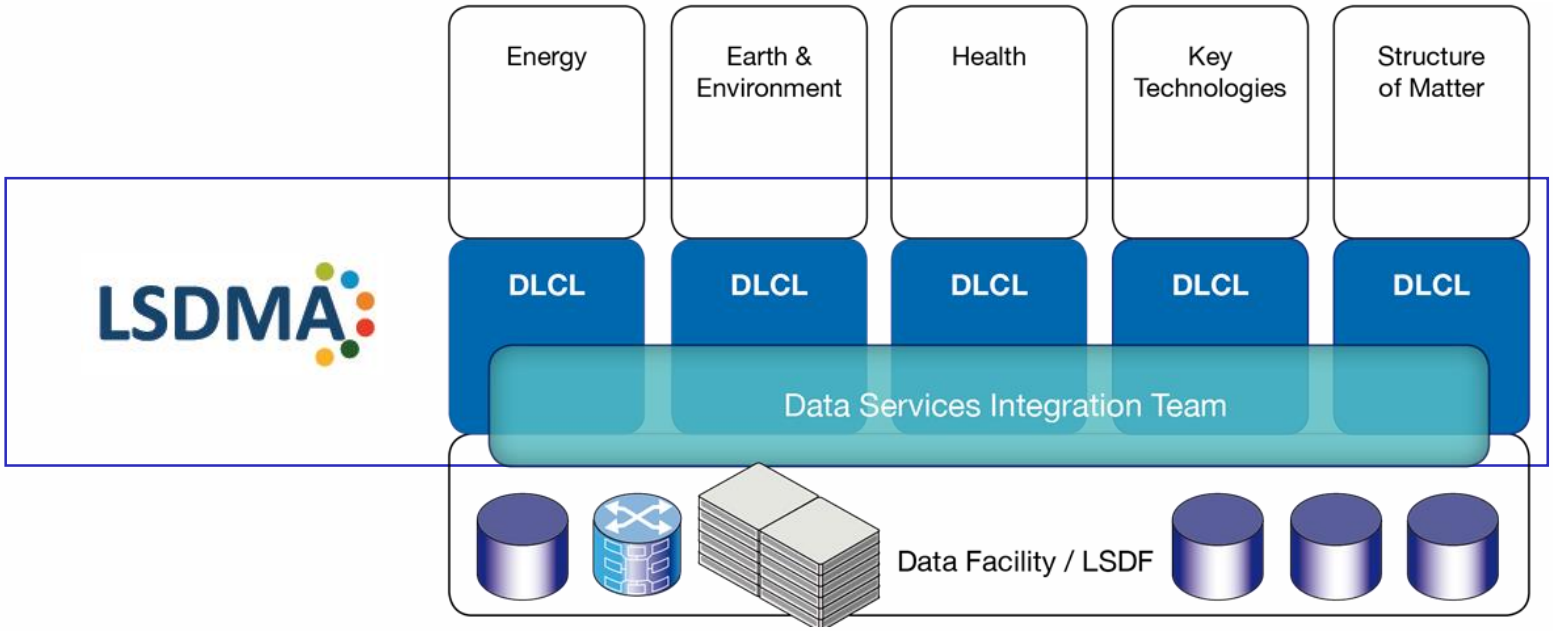
Overview

LSDMA Overview

Selected Highlight Activities

Experiences and Summary

LSDMA: Dual Approach



Data Life Cycle Labs

Joint R&D with scientific user communities

- Optimization of the data life cycle
- Community-specific data analysis tools and services

Data Services Integration Team

Generic methods R&D

- Data analysis tools and services common to several DLCLs
- Interface between federated data infrastructures and DLCLs/communities

LSDMA Facts & Figures

Initial duration: 2012-2016

- Project is a Helmholtz portfolio extension → inclusion of activities into Helmholtz program-oriented funding in 2015, cross-program initiative

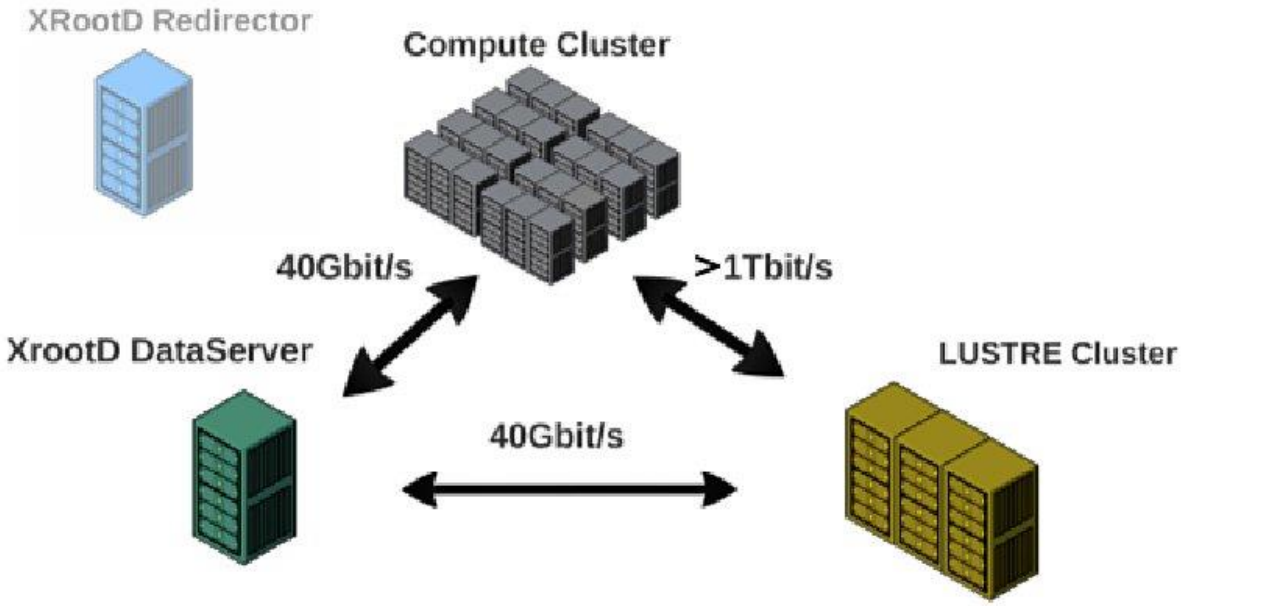
Partners:

- Helmholtz Association: KIT, DESY, FZJ, GSI
- External: DKRZ, U-Heidelberg, U-Ulm, TU-Dresden, U-Hamburg, HTW-Berlin, U-Frankfurt

Coordination: KIT

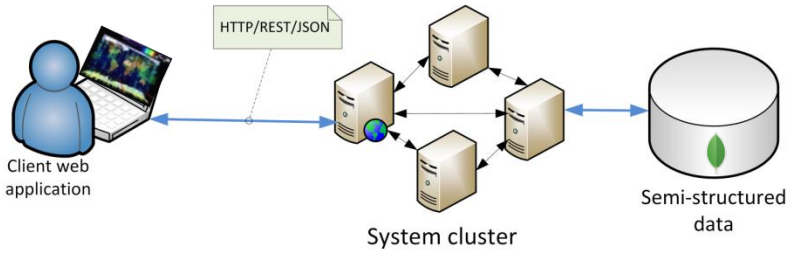
DLCL Structure of Matter: FAIR@GSI

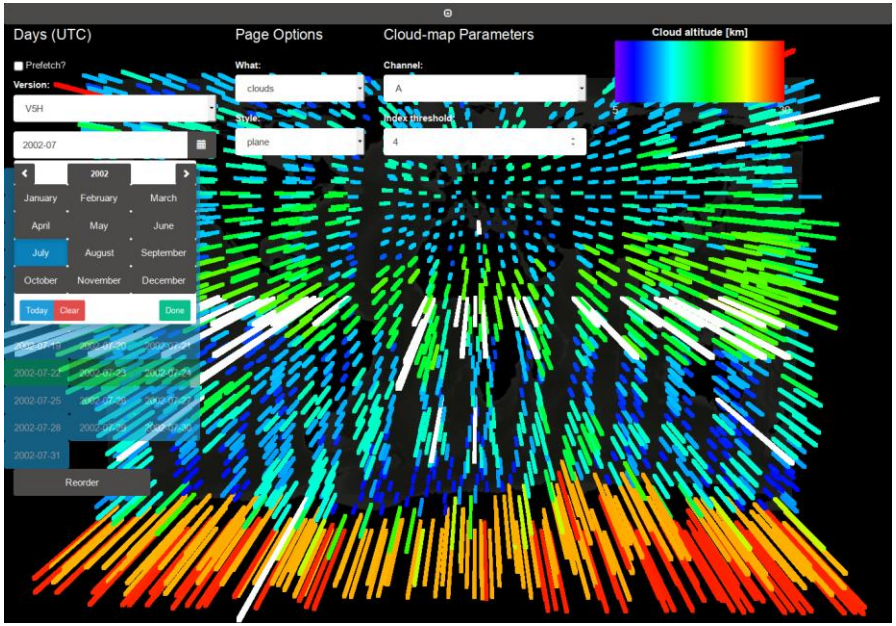
- GSI hosts the German ALICE T2 centre, providing 7% of the ALICE T2 resources
- ALICE T2 jobs run in a multi - purpose HPC centre. Data to/from the HPC environment are tunneled through an XrootD forward proxy
- Storage Element: XrootD data servers on top of Lustre file system - an XrootD client plugin can provide direct access to Lustre for jobs running at GSI.
- experience gained in context of ALICE T2 provide an important guideline for the forthcoming distributed computing environment of FAIR



DLCL Climatology

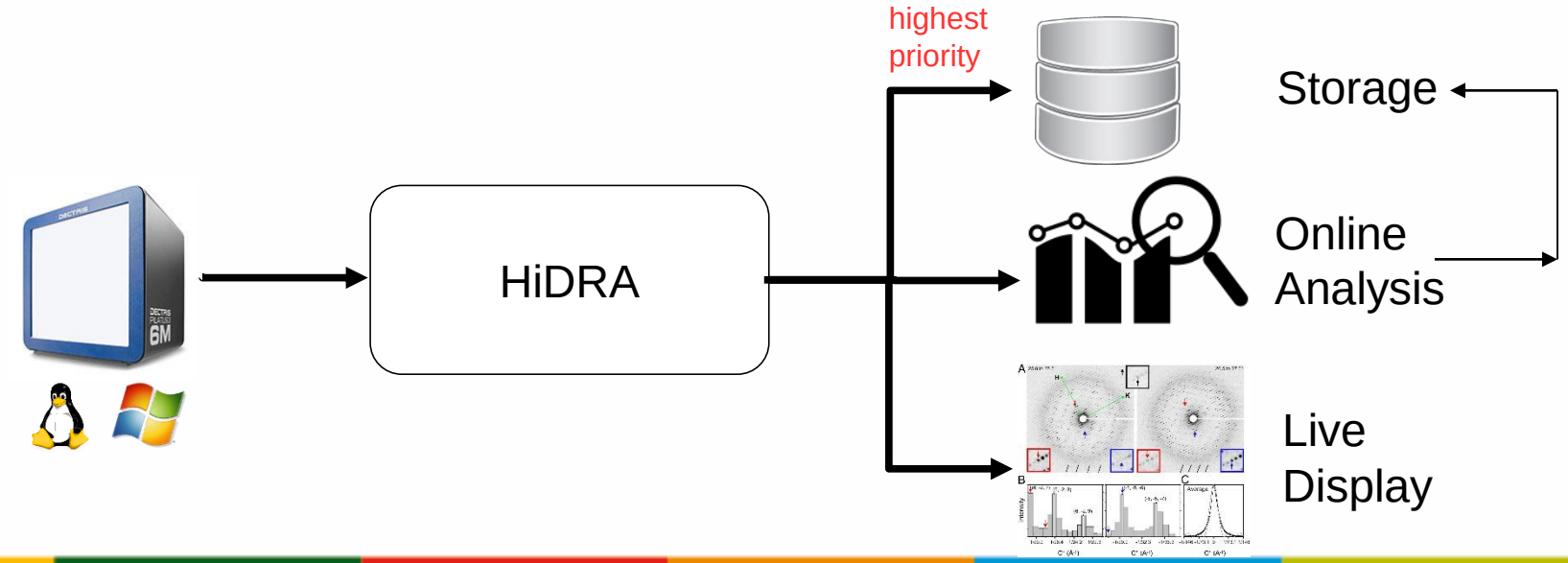
- browser application for visualization of large amount of unstructured data (MIPAS)
- 3D-visualization: WebGL
- MEAN stack
- web service API for MongoDB and predefined use cases
- node.js cluster to perform preprocessing of MongoDB data
- framework with frontend/backend workers, controller, scheduler





DLCL Structure of Matter: HiDRA – Petra III & Flash @DESY

- Problem:
  - data has to be drained from the detectors fast enough (>30Gb/sec)
  - experimental conditions have to be monitored and analyzed in close to real time to prevent the collection of unfavorable data, which also helps with preserving the valuable sample (online analysis)
- HiDRA is a generic tool set for high performance data multiplexing with different qualities of service based on Python and ZeroMQ



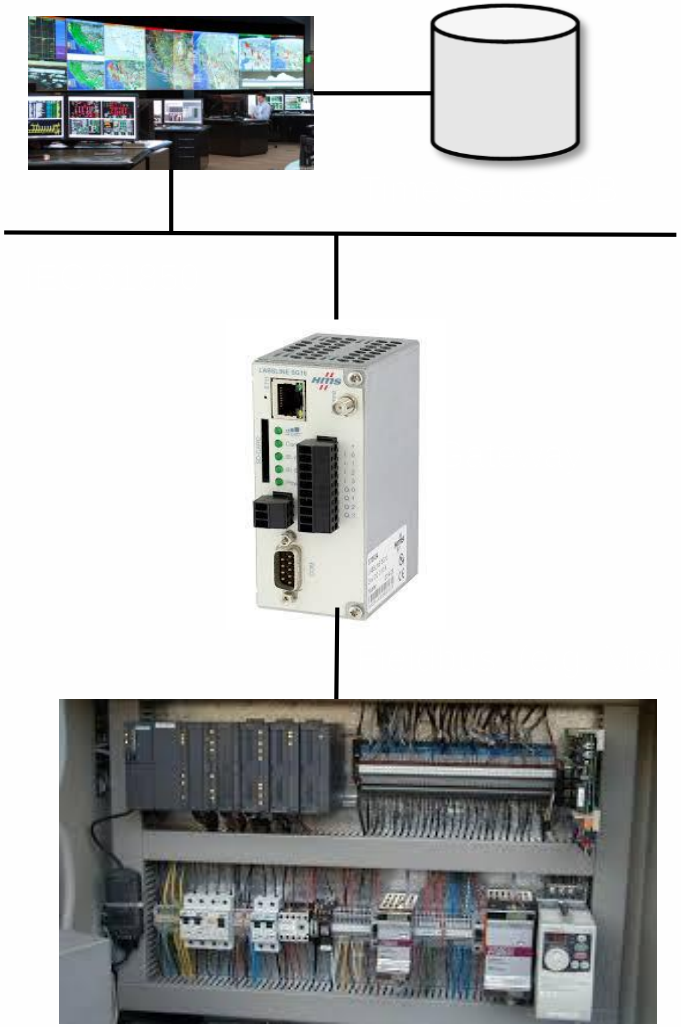
DLCL Energy: Energy Lab 2.0

Energy Lab 2.0: An energy grids simulation and analysis laboratory incl.

- Simulation platform
- Microgrid - test field
- Power-hardware-in-the-loop
- KIT Energy Smart Home Lab
- FZI House of Living Labs

Main tasks of the DLCL Energy in the Energy Lab 2.0:

- Energy data / time series management
- Standardized data access



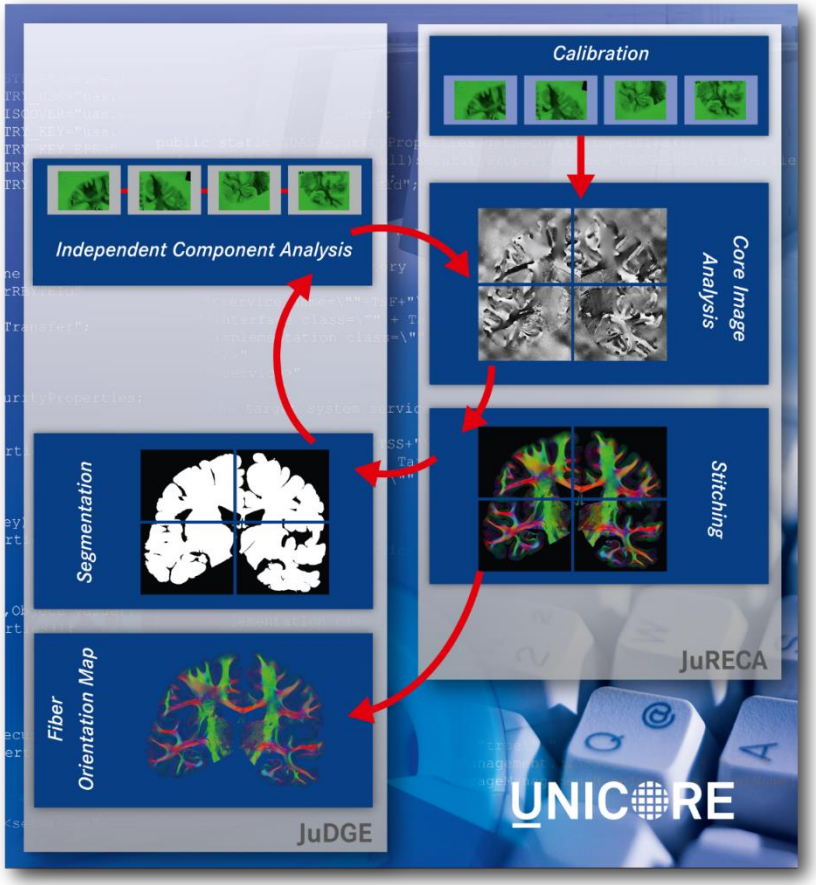
DLCL Neuroscience: 3D Polarized Light Imaging Workflow

Goals and Methods

- Generation of high-resolution, large-scale brain models describing nerve fiber architecture
- Acquisition of imaging data by Polarized Light Imaging (3D-PLI) technique
- 2500 serial images of histological sections per human brain
- ~750 GB data processed per section and 3D-PLI workflow execution
- Complex chain of image processing tools
- Integration of tool chain in UNICORE workflow system

Results

- Significant speedup of execution time by level of automation (reduced from days to hours)
- Abstraction - Enabled users to perform complex data analysis without deep knowledge of tools
- Large-scale distributed supercomputing and data sharing across various platforms



DLCL Key Technologies

Data repositories

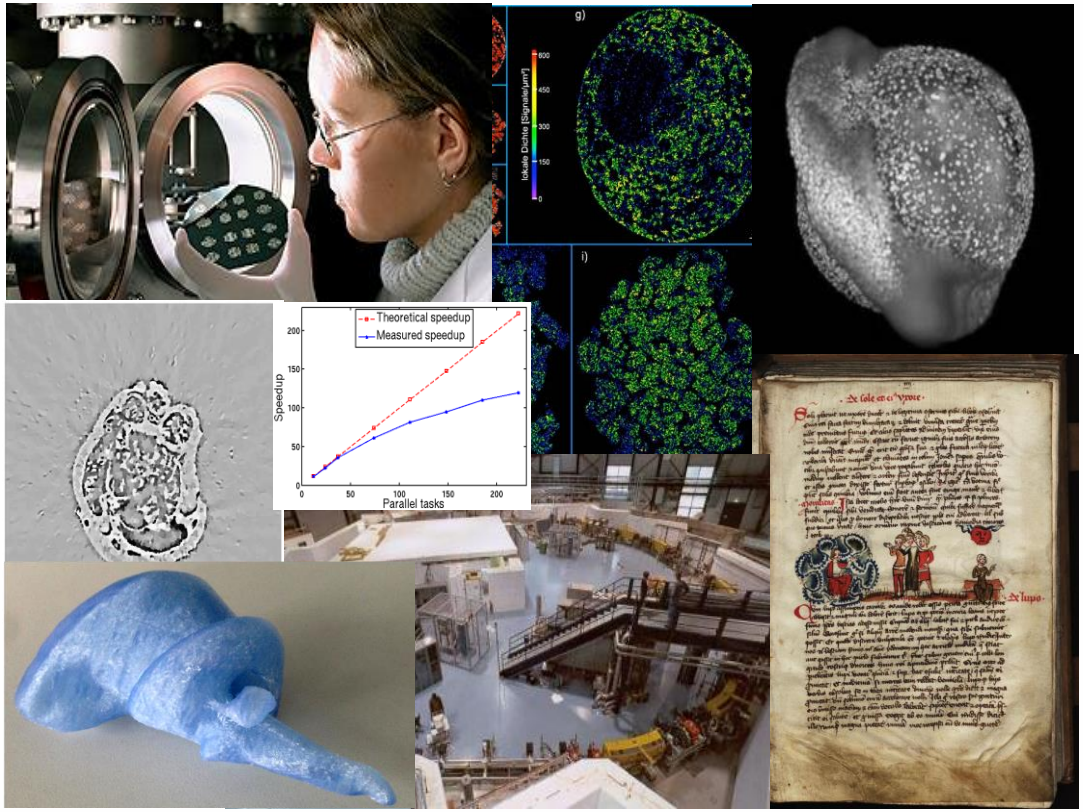
- Distributed
- Special-purpose

Data description for re-use (metadata): data provenance

Data analytics:

- Automatic feature (metadata) extraction
- Tools

Algorithms



DSIT Highlight: align AAI with European context

- Authentication and Authorisation Infrastructure:
  - Concepts and Pilots:
    - => AARC (Authentication and Authorisation for Research Communities)
  - Infrastructure development and deployment:
    - ⇒ INDIGO-DataCloud

- Building the bridge between X.509, SAML and OpenID-Connect (OIDC)
  - Users are in SAML-home IdPs
  - Services may be in OIDC, X.509 and SAML

DSIT: More Highlight Activities

Unicore

- Extended to support REST (not just SOAP)
- Extended to support map-reduce
- Generic interface for metadata management

Extensive performance measurement and tuning of Lustre / ZFS

- Adaptive Data Reduction
- Parallel Snapshots

KIT-Data-Manager: a repository system for large data released as open source

dCache

- CDMI Support
- QoS for Storage support

Experiences and Summary

Experiences:

- Needs of communities vary immensely, even within research areas
- Communities‘ interest in new tools and methods fueled by need and by new research potential
- Automation of procedures still very often a quick win
- Interoperable AAI well on its way
- Policies (e.g. Open Data) and legal regulations (e.g. data privacy) are additional challenges

Summary

- For five years, LSDMA has advanced selected scientific communities in their data management and analysis
- Communities highly profited from this work
- Dual approach was a great choice