First implementation of our ideas by INDIGO-DataCloud

Patrick Fuhrmann
From the Paper “Advances in Cloud”

EC Expert Group Report on Cloud Computing,

The Expert Group identified the following unsolved issues in the currently deployed ecosystem:

• Open Interoperation across (proprietary) Cloud solutions at IaaS, PaaS and Saas level has not yet been developed.
• No solutions are available to manage multitenancy at large scale and heterogeneous environments.
• No dynamic and seamless elasticity from in-house Cloud to public Clouds ...
• Datamanagement: Problems with bandwidth, security and privacy between public and private clouds.
INDIGO-DataCloud

- **An H2020 project** approved in January 2015 in the EINFRA-1-2014 call
  - 11.1M€, 30 months (from April 2015 to September 2017)
- **26 European partners** in 11 European countries
  - Coordination by the Italian National Institute for Nuclear Physics (INFN)
  - Including developers of distributed software, industrial partners, research institutes, universities, e-infrastructures
- **Develop an open source Cloud platform** for computing and data (“DataCloud”) tailored to science.
- **Targeting Multi-disciplinary scientific communities**
  - E.g. structural biology, earth science, physics, bioinformatics, cultural heritage, astrophysics, life science, climatology
- **Deployable on hybrid (public or private) Cloud infrastructures**
  - INDIGO = INtegrating Distributed data Infrastructures for Global ExplOitation
- **In response** to the technological needs of scientists seeking to easily exploit distributed Cloud/Grid compute and data resources.
User (Scientist) first
Users first: from here...

**Use-Cases from**
- LifeWatch
- EuroBioImaging
- INSTRUCT
- LBT
- CTA
- WeNMR
- ENES
- eCulture
- ELIXIR
- EMSO
- Dariah
- WLCG

100 distinct requirements

**Computational**
- Software as a Service
- Execution of Workflows
- Cloud Bursting
- X-Site Execution
- Improved Scheduling
- Access to GP-GPU’s

**Storage**
- Distributed Storage, accessible via POSIX
- Persistent Data Storage

**Infrastructure**
- Global Level AAI
- Software Defined Networks

Converted to concrete activities in the Project DoW
... to here ... Community Case Studies

Report on how several scientific communities are implementing their own requirements into concrete applications using INDIGO-DataCloud components.

- Monitoring and Modelling Algae Bloom in a Water Reservoir
- TRUFA (Transcriptomes UserFriendly Analysis)
- Medial Imaging Biobanks
- Molecular Dynamics Simulations
- Astronomical Data Archives
- Archive System for the Cherenkov Telescope Array (CTA)
- HADDOCK Portal
- DisVis
- PowerFit
- Climate models inter comparison data analysis
- eCulture Science Gateway
- EGI FedCloud Community Requirements
- ELIXIR-ITA: Galaxy as a Cloud Service
- MOIST – Multidisciplinary Oceanic Information System
- Data Repository platform for DARIAH

https://www.indigo-datacloud.eu/documents-deliverables

October 2016  Patrick Fuhrmann - The INDIGO-DataCloud MidnightBlue Release
Using “Champion” approach:

Communities have to provide a scientist, becoming an expert in computing and INDIGO terminology.
Now about QoS in Storage
Where it came from ...

Amazon
- S3 : online
- Glacier : nearline

Google
- Standard
- Durable Reduces Availability (DRA)
- Nearline

IBM (HPSS, GPFS)
- Storage classes (user defined)

dCache
- Storage groups (user defined)
- Tape
- Disk (spinning or SSD)
- Resilient Management (‘n’ copies)
The first ideas for a solution

Platform as a Service

Canonical Storage Property Information System

D&M

GUI

REST API

D&M

GUI

REST API

IaaS

D&M

D&M
Theoretical approach .....
Since we only had 30 months and Augusto would like to see some results ...

- Built a common (agreed) vocabulary e.g. within RDA
- Map agreed vocabulary to protocol spec, e.g. with SNIA
- Provide a reference Implementation
Protocol decision

• The decision to use CDMI (SNIA) as the QoS control protocol was already made at the time of the proposal.

• Very difficult to change this decision, as CDMI was the only industry standard, somehow working in our direction.

• So we joined SNIA

• And contributed to the CDMI reference implementation.

• We actually moved it into GitHub and made it usable.

• Although we started with the SNIA reference implementation, we had to rewrite a large part of it.
The CDMI SNIA Part

SNIA : The Storage Networking Industry Association

The Storage Networking Industry Association (SNIA) is a non-profit organization made up of member companies spanning information technology. A globally recognized and trusted authority, SNIA’s mission is to lead the storage industry in developing and promoting vendor-neutral architectures, standards and educational services that facilitate the efficient management, movement and security of information.
The SNIA Cloud Data Management Interface (CDMI) is an ISO/IEC standard that enables cloud solution vendors to meet the growing need of interoperability for data stored in the cloud. The CDMI standard is applicable to all types of clouds—private, public and hybrid. There are currently more than 20 products that meet the CDMI specification.
INDIGO Products on SNIA Web Pages

Shipping Commercial CDMI Servers

Arsys CloudStorage (Powered by Scality)

**Indigo Project - Storage Quality of Service and Data Lifecycle**

Coho Data
Compuverde Object Store
Critical Path Messaging Platform (Powered by Scality)
DDN WOS
Mezeo MezeoCloud (Zimbra)
NetApp StorageGRID 9
NetApp StorageGRID Webscale
ProphetStor
Scality Ring
SGI OmniStor (Powered by Scality)
Tarmin GridBank
XOR Systems - Cloud Aqua

Open Source CDMI Servers

CDMI-Server
dCache
FI-WARE Project
JClouds
OpenStack Swift
SNIA CDMI Reference Implementation
Stoxy
Venus-C

April 2017
Patrick Fuhrmann – RDA 9th Plenary
CDMI Considerations

- CDMI is an industry standard.
- CDMI is not very widely spread.
- CDMI doesn’t cover our use cases.
- But CDMI provides the possibility of ‘extensions’, which we are using.
- Based on our experience with WLCG (Storage Resource Manager) we have a much better idea on how to define those protocols than SNIA.
  - QoS in CDMI is very much shoehorned.
  - Multi user QoS transitions are not mapped correctly.
  - INDIGO, based on its DoW was bound to CDMI.
- INDIGO is going on SNIA’s nerves. 😊
The Architecture

Generic CDMI Web Service
Java Service Provider Interface (SPI)
HPSS Plug-in
CEPH/StoRM
dCache Plug-in
REST <-> HPSS API

HPSS
High Performance Storage System
Evaluation Deployment

- KIT (master server)
- KIT (GPFS, HPSS, mixed Tape, Disk)
- CNAF (StoRM)
- DESY (dCache, mixed Tape, Disk)
- Poznan (CEPH)
# Federated View (Real Screenshot)

## Available Qualities of Storage

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<th>Name</th>
<th>Access Latency [ms]</th>
<th>Number of Copies</th>
<th>Storage Lifetime</th>
<th>Location</th>
<th>Storage type</th>
<th>Available Transitions</th>
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<td>3</td>
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QoS dCache View (Real Screenshot)
Conclusion

• Apologies for not doing it the “right way”
• But we had to provide an implementation within 30 months.
• However, we can prove that we are serious.
• Process with SNIA is painful but helps to understand the difficulties, to map our ideas to a real protocol.
• Implementing the protocol helps to understand the issues with the different storage systems.
• We even now support limited transitions.
  • Dangerous !!! (Tape is a tricky beast 😊)
The End

https://www.indigo-datacloud.eu

Better Software for Better Science.
• Brokering IG and Brokering WG

• Vocabulary groups

• NEW : data preservation :

• Overlap with data management plans.