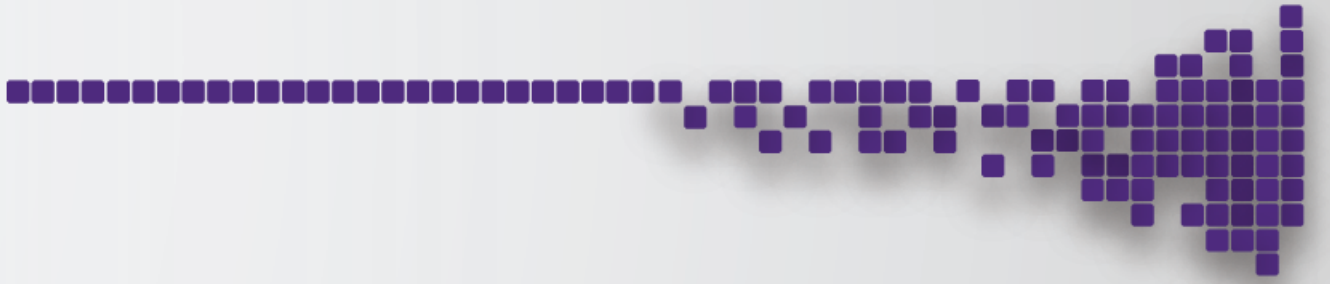
RIA-653549

Quality of Service in Storage by INDIGO-DataCloud



Anupam Ashish

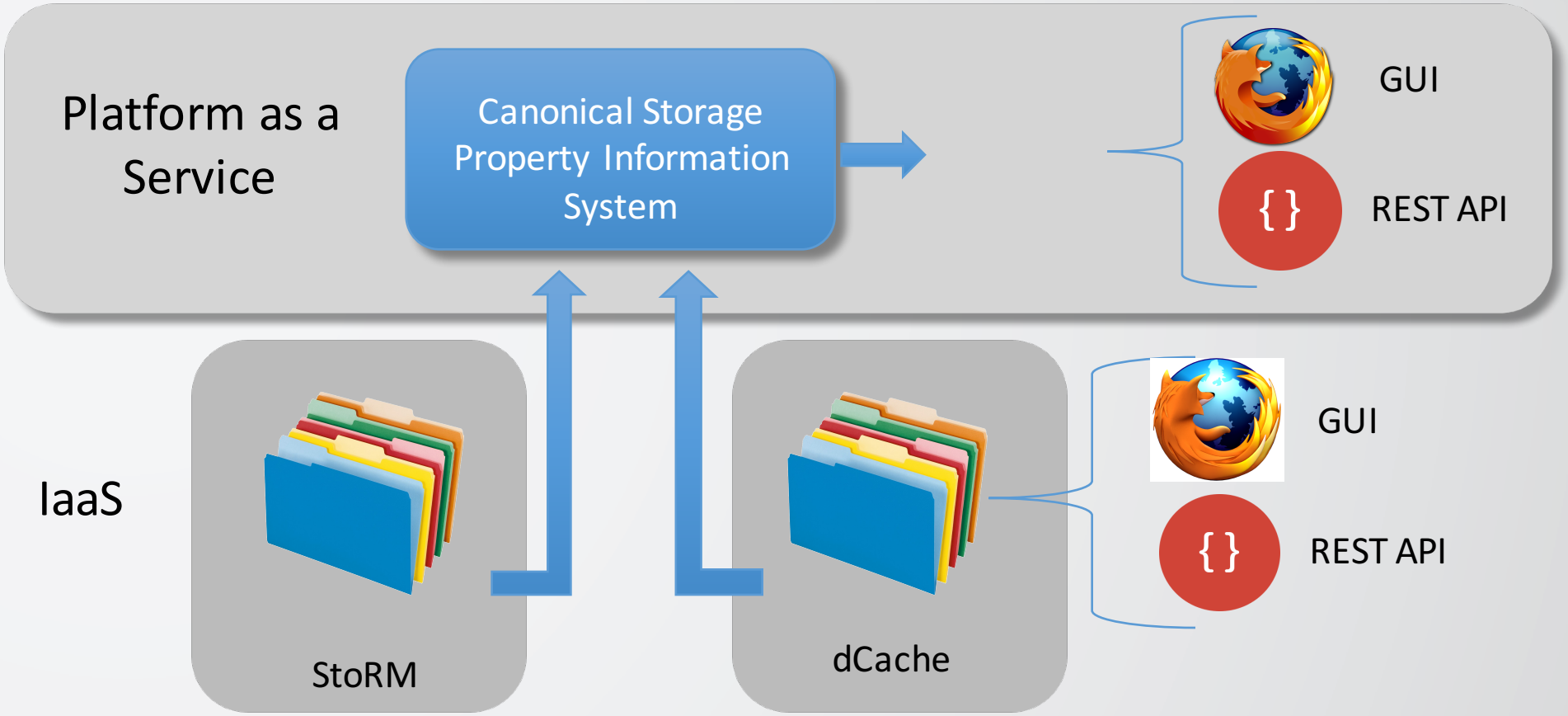
INDIGO-DataCloud is co-founded by the Horizon 2020Framework Programme

Where did it come from?

INDIGO - DataCloud

- Amazon
  - S3 : online
  - Glacier : nearline
- Google
  - Standard
  - Durable Reduces Availability (DRA)
  - Nearline
- IBM (HPSS, GPFS)
  - Storage classes (user defined)
- dCache
  - Tape
  - Disk (spinning or SSD)
  - Resilient Management (‘n’ copies)

First Ideas


Platform as a Service
Canonical Storage Property Information System
GUI
{ }
REST API
IaaS
StoRM
dCache
GUI
{ }
REST API

The INDIGO – DataCloud Approach

INDIGO - DataCloud

Built a common (agreed) vocabulary for Data Management

Map agreed vocabulary to a QoS protocol spec

Provide a reference Implementation

CDMI Cloud Data Management Interface

- SNIA Cloud Data Management Interface (CDMI)
  - ISO/IEC standard
  - Interoperability for Data stored in the cloud
    - Cloud solution vendors

- More than 20 products that meet the CDMI

Storage Networking Industry Association

- Non-Profit Organization
  - Industrial and Scientific members from information technology
- Mission
  - Promoting vendor-neutral architectures
  - Standards and Educational Services
- Facilitate
  - Efficient Management of Data
  - Movement of Data
  - Security of Data

CDMI v1.1.1

INDIGO - DataCloud

- Discover capabilities available with storage provider
- Manage containers and the data that is placed in them
- RESTful principles in the interface design
- Providers can support a subset of CDMI
  - Must expose the limitations in the capabilities reported

CDMI v1.1.1

- Object Model
  - Data Objects ⟷ Files
    - Store Values
  - Containers ⟷ Directories
  - Capability Object
    - Functionality provided by the storage system
    - Each data object or container has one or more capability objects
      - cdmi_retention_period
- QoS Class
  - Collection of capability objects

CDMI v1.1.1

- Some Quality of Storage Attributes available
  - Data Redundancy cdmi_data_redundancy
  - Geo-Location cdmi_geographic_placement
  - Latency cdmi_latency
  - Retention cdmi_retention_period

- Data System can express an actual value to the exposed attributes
  - Geo-Location DE
  - Latency 3000
- User can request a specific value during data creation or update
  - Geo-Location FR, DE, JP

CDMI Considerations

- CDMI is an industry standard.
  - Allows dCache to express its QoS for other systems
- Not widely Used
- Doesn’t cover our use cases
  - Transition from one QoS to other
    - No clear way to determine if
      - the transition is allowed or
      - the system is capable of providing time
  - Lifetime of QoS
    - Pinning in dCache
    - Lock QoS on a data object

CDMI Considerations

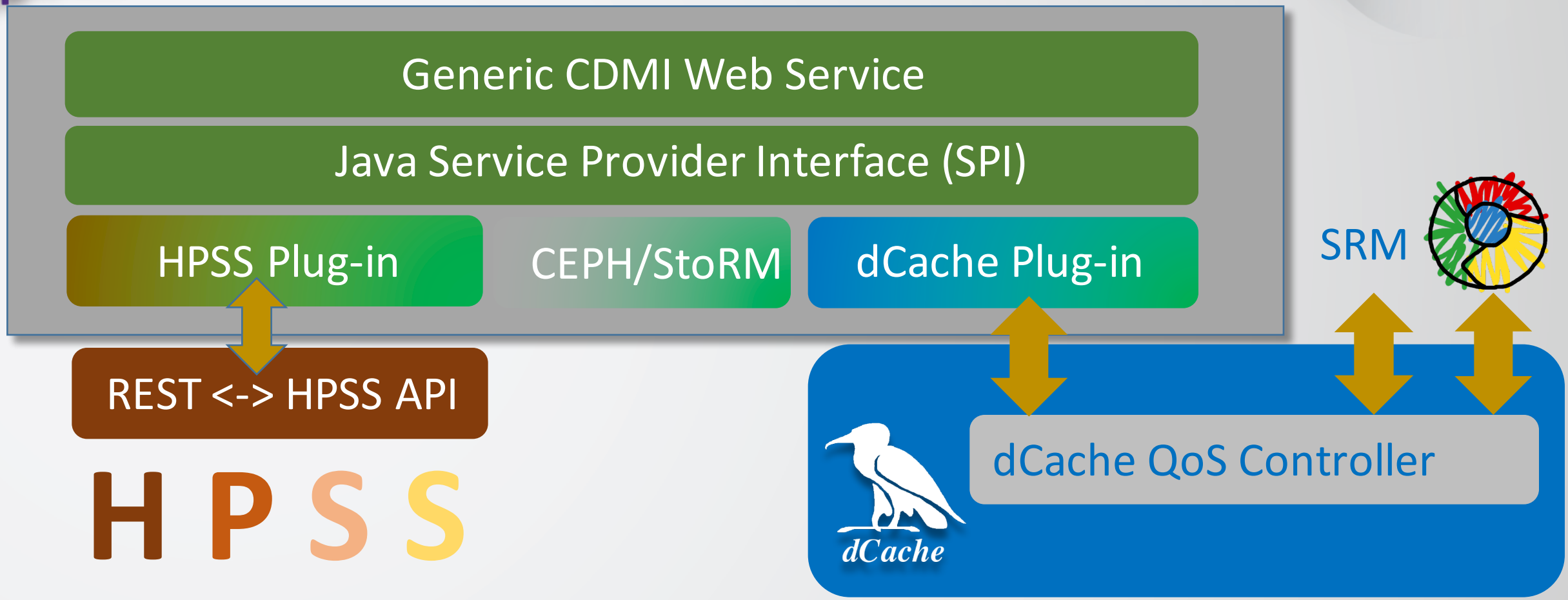
INDIGO - DataCloud

- Pros
  - CDMI is an industry standard.
  - Allows dCache to express its QoS for other systems
- Cons
  - Not widely Used
  - Transition from one QoS to other
    - No clear way to determine if
      - the transition is allowed or
      - the system is capable of providing time
  - Can’t express Lifetime of QoS
    - Pinning in dCache
    - Lock QoS on a data object
  - No way to manipulate the set of capabilities

INDIGO CDMI Extension

- Default attributes based on storage system configuration
- Assign QoS Class on creation and update of objects
- Changes to QoS restricted
  - Discover allowed transitions from one QoS Class to another
  - To the ones permitted by the storage system
  - Changes to individual capability of a QoS class not allowed
- Attribute for Capability Lifetime
- Additional attribute for monitoring QoS transitions

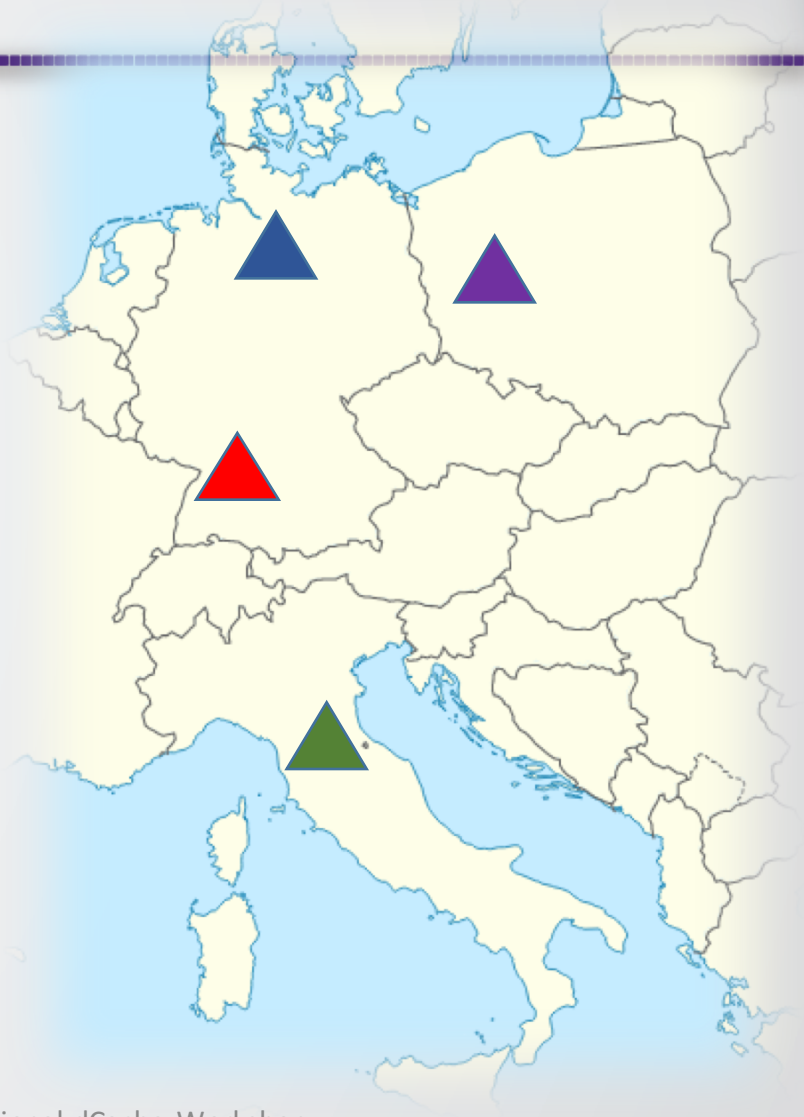
INDIGO QoS Architecture



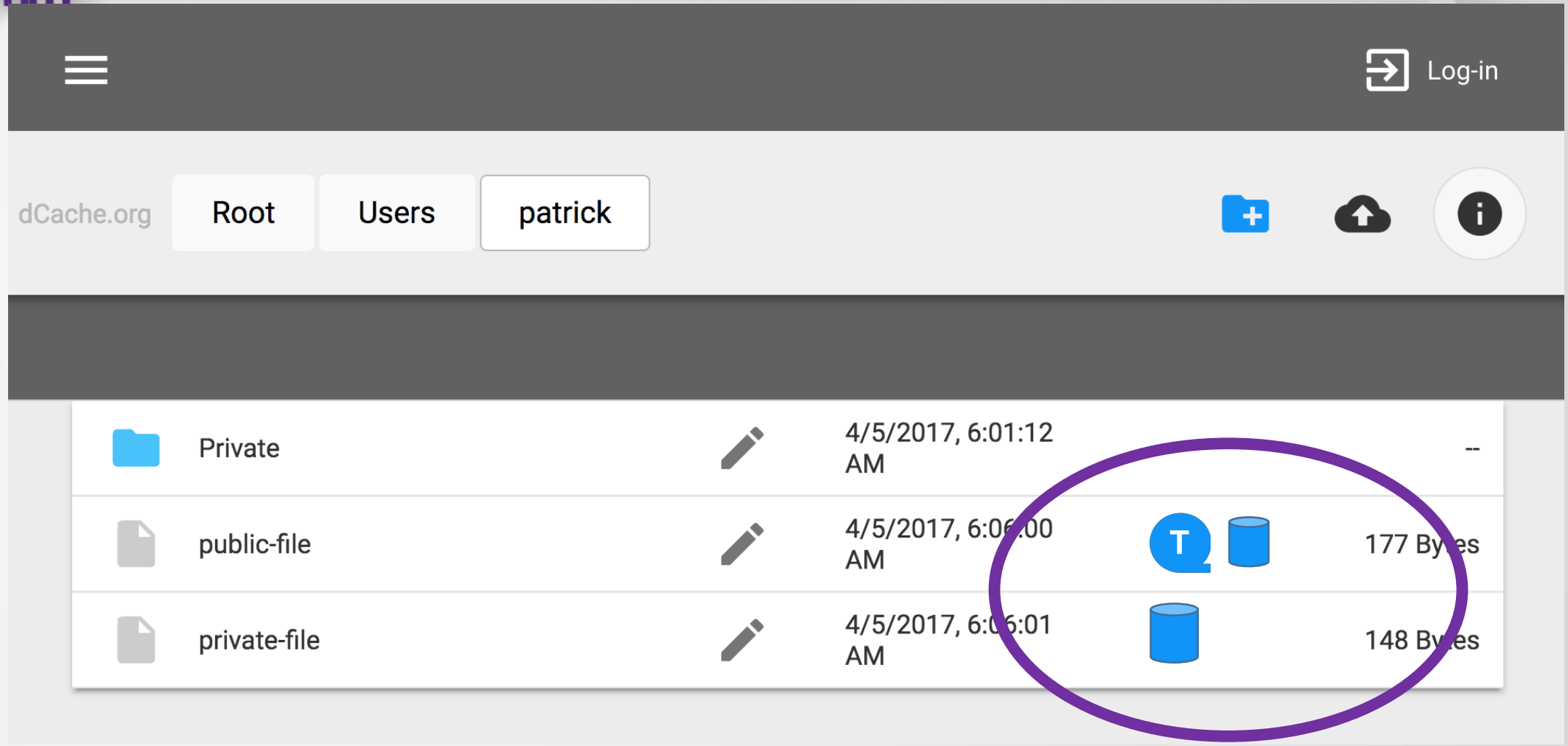
Current Deployment

INDIGO - DataCloud

- KIT (master server)
- KIT (GPFS, HPSS: Tape, Disk)
- CNAF (StoRM: disk for now)
- DESY (dCache: Tape, Disk)
- Poznan (CEPH: disk only)



Infrastructure View



Federated View

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Available Qualities of Storage

Name	Access Latency [ms]	Number of Copies	Storage Lifetime	Location	Storage type	Available Transitions
DataobjectProfile1	3000	1	20 years	PL	Archival	
DataobjectProfile2	2000	2	20 years	PL, UK	Archival	
DataobjectProfile3	500	3	20 years	NL, ES, PL	Archival	
disk	100	1		DE	Process	
disk+tape	100	2		DE	Process	
DiskAndTape	50	3	20 years	DE	Process	
DiskAndTape	50	2		IT	Process	
DiskOnly	50	3	20 years	DE	Process	
DiskOnly	50	1		IT	Process	

Collected Capabilities

- Access Latency
- Number of Copies
- Storage Lifetime
- Location
- Available Transition

Back to Infrastructure View

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KIT / DiskOnly

Data storage lifetime	20 years
Latency	10
Throughput	4194304
Capability lifetime action	migrate-to:/cdmi_capabilities/dataobject/DiskAndTape
Capabilities allowed	
Capability lifetime	0:30:00
Geographic placement	• DE
Data redundancy	3

The End

https://www.indigo-datacloud.eu

Better Software for Better Science.

The End

https://www.indigo-datacloud.eu

Better Software for Better Science.

Conclusion

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- 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 ☺)

- Brokering IG and Brokering WG

- Vocabulary groups
- NEW : data preservation :
- Overlap with data management plans.