



The eXtreme –DataCloud project

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+ The XDC Project

- The eXtreme DataCloud (XDC) develops scalable technologies for federating storage resources and managing data in highly distributed computing environments
- INFRA-21-2017 Call, 3Meuros, 8 partners, 27 Months
- It is based on existing tools (TRL8+) that the project will enrich with new functionalities and plugins already available as prototypes (TRL6+)
- The targeted platforms are the current and next generation e-Infrastructures deployed in Europe
 - European Open Science Cloud (EOSC)
 - The e-infra used by the represented communities (including WLCG)

ID	Partner	Country	Represented Community	Tools and system
1	INFN (Lead)	IT	HEP/WLCG	INDIGO-Orchestrator, Smart caching mechanisms, Access pattern analyzer
2	DESY	DE	Research with Photons	dCache, Orchestrator, Smart Caching mechanisms
3	CERN	CH	HEP/WLCG	EOS ,DYNAFED, FTS, Smart Caching mechanisms
4	AGH	PL		ONEDATA
5	ECRIN	[ERIC]	Medical data	
6	UC	ES	Lifewatch	
7	CNRS	FR	Astro [CTA and LSST]	
8	EGI.eu	NL	EGI communities	

+ Summary of the technical topics - 1

- Intelligent & Automated Dataset Distribution
 1. Orchestration to realize a policy-driven data management
 2. Data distribution policies based on Quality of Service (i.e. disks vs tape vs SSD) at **infrastructure level** (cross-sites)
- A typical workflow
 - Initially the data will be stored on low latency devices for fast access
 - To ensure data safety, the data will be replicated to a second storage device and will be migrated to custodial systems, which might be tape or S3 appliances
 - Eligible users will get permission to restore archived data if necessary
 - After a grace period, Access Control will be changed from “private” to “open access”

+ Summary of the technical topics - 2

- Data pre-processing during ingestion
 1. Automatically run user defined applications and workflows when data are uploaded
 1. i.e. for Skimming, indexing, metadata extraction, consistency checks
- Implement a solution to discover new data at specific locations
- Create the functions to request the INDIGO PaaS Orchestrator to execute specific applications on the computing resources on the Infrastructure
- Implement a high-level workflow engine, that will execute applications defined by the users
- Implement the data mover to store the elaborated data in the final destination

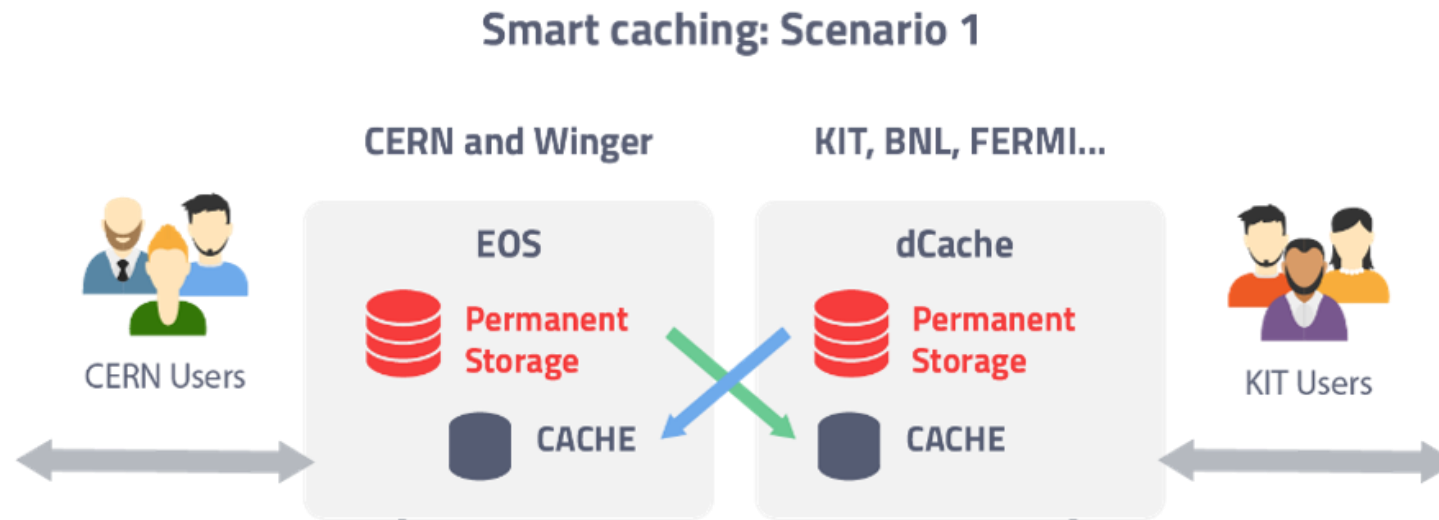


Summary of the technical topics - 3

- ❑ Data management based on access patterns
 1. Move to ‘glacier-like’ storage unused data, move to fast storage “hot” data (at infrastructure level)
 2. access predictions to improve data availability

- ❑ Smart caching
 - Develop a global caching infrastructure supporting the following building blocks:
 - dynamic integration of satellite sites by existing data centres
 - creation of standalone caches modelled on existing web solutions
 - federation of the above to create a large scale caching infrastructure

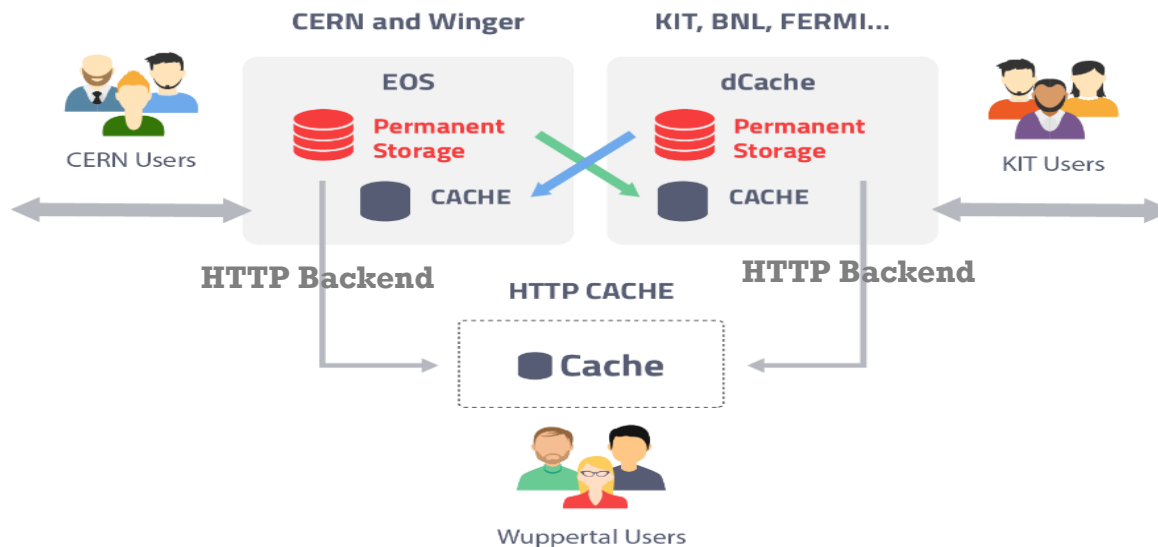
+ Smart caching scenarios - 1



- ❑ The dynamic extension of a site to remote locations.
- ❑ Data stored in the original site should be accessible from the remote location in a “quasi”-transparent way from the clients’ points of view.
- ❑ Implemented in EOS, ONEDATA and dCache using internal namespaces and algorithms. The cache is not addressable.

+ Smart caching scenarios – 2

Smart caching: Scenario 1

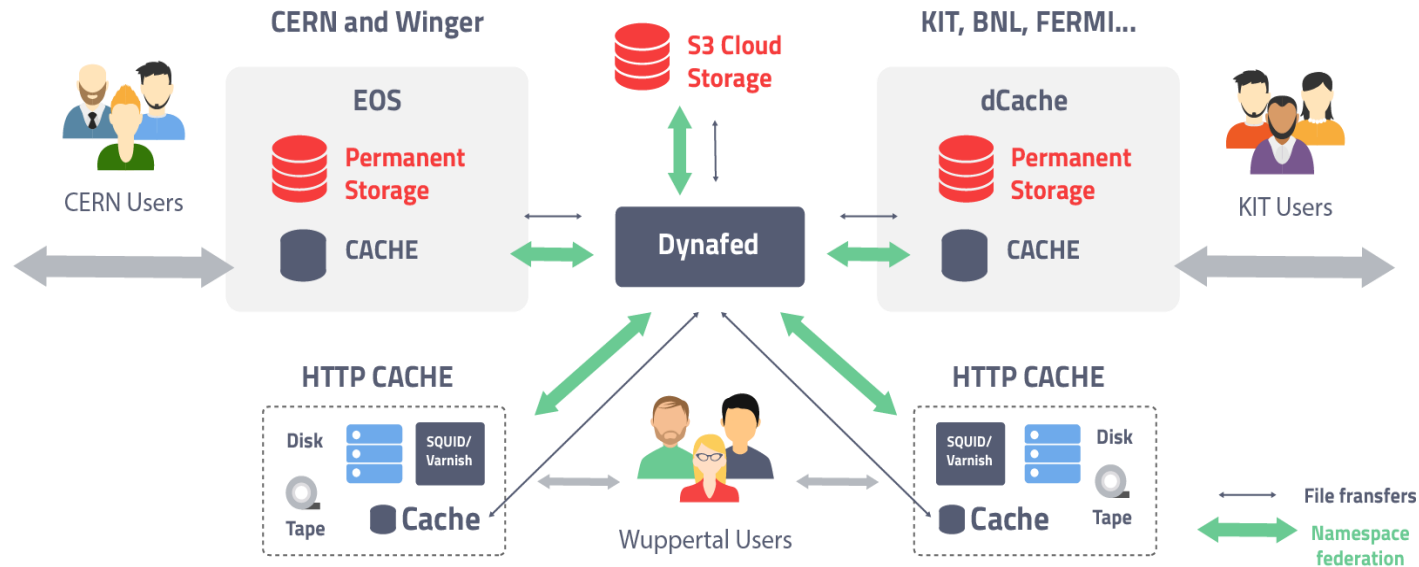


- ❑ A tactical storage set up as a stand-alone cache
 - ❑ e.g. in running squid-like services
- ❑ Clients access the cache directly
- ❑ The cache will fetch data on a miss (or at least redirect the client)
- ❑ The cache is federable, as it is directly addressable
 - ❑ Cache federation at a site for scalability
- ❑ The cache namespace will be done via a federator that is not embedded into the storage systems (i.e Dynafed).

See Furano et al. "Web cache for grid HTTP access", 04/2014

+ Smart caching scenarios - 3

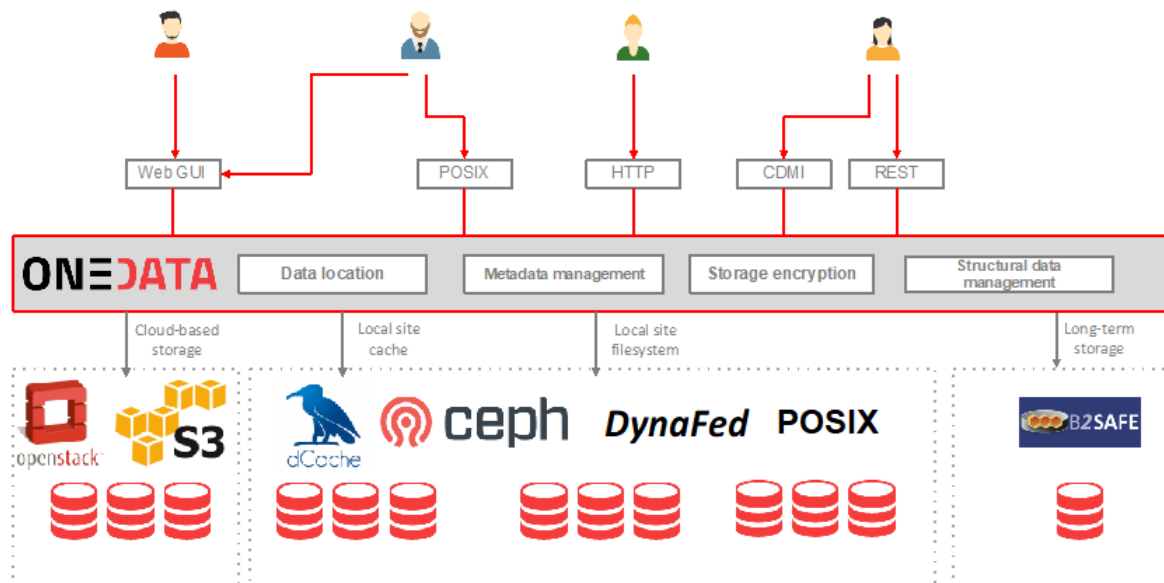
Smart caching: Scenario 3



- The creation of a permanent “Virtual Data Cloud”
 - storage resources (Grid and Cloud) federated in a single namespace
 - remote data can be accessed transparently from any location without the need of explicitly copying them on the client location
- As an extension of the previous scenario, this implies the creation of a distributed and federated cache system

Summary of the technical topics - 4

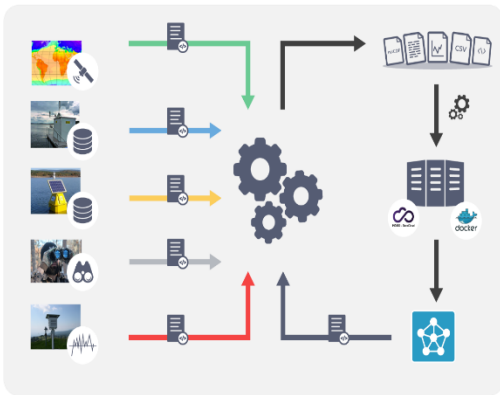
- ❑ Unified data access platform at a PaaS level at the Exascale
 - ❑ Multi-region support in ONEDATA
- ❑ Advanced metadata management with no pre-defined schema
- ❑ Encryption Services and Secure Storage
 - ❑ Sensitive data management and key storage within ONEDATA



Metadata handling use cases

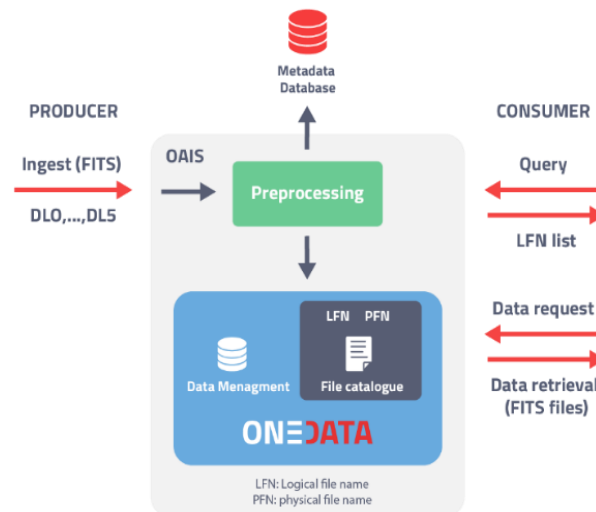
LIFEWATCH

- Metadata management to handle heterogeneous and large datasets
- Different data types, formats, source and ways to access
- e.g. Copernicus data: ~16PB per year
- Used as input for water quality forecasting systems
- Use of standards like EML (Ecological Metadata Language) and adopting best practices like FAIR+R principles



CTA

- The CTA distributed archive lies on the « Open Archival Information System » (**OAIS**) **ISO standard**. Event data are in files (FITS format) containing all metadata.
- Metadata are extracted from the ingested files, with an automatic filling of the metadata database.
- Metadata will be used for the further query of archive.
- The system should be able to **manage replicas**, tapes, disks, etc, with data from low-level to high-level.



ECRIN

- Clinical trial data objects available for sharing with others
 - a variety of access mechanisms
 - wide variety of different locations
 - growing number of general and specialised data repositories
 - trial registries
 - Publications
 - the original researchers' institutions
- 'discoverability' will become much worse in the future as more and more materials is made available for sharing



XDC functionalities/community /tool matrix

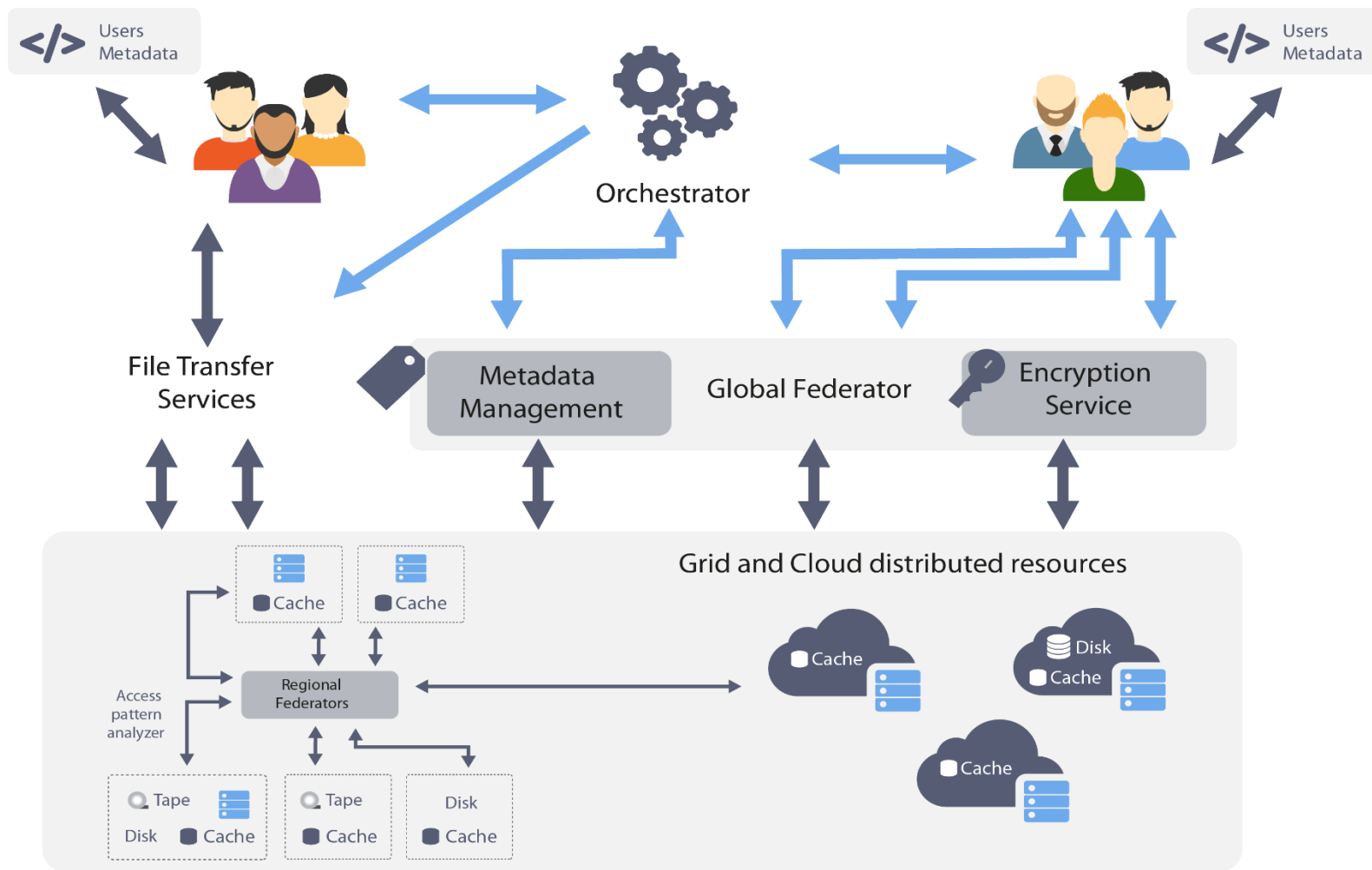
A use case driven project...

Functionalities	Research Communities				
	ECRIN	WLCG	XFEL	LifeWatch	CTA
Metadata mgmt	Onedata			Onedata	Onedata
Encryption	Onedata				
Key mgmt	Onedata				
Pre-processing	Orchestrator Onedata			Orchestrator Onedata	Orchestrator Onedata
Smart caching		dCache EOS Dynafed Squid-like tools	dCache EOS Dynafed Squid-like tools	Onedata	Onedata
Data lifecycle mgmt			Orchestrator CDMI FTS		
Policy driven data mgmt based on QoS		Orchestrator CDMI FTS Dynafed	Orchestrator CDMI FTS Dynafed	Orchestrator CDMI Onedata	Orchestrator CDMI Onedata FTS

...new functionalities added on top of existing production quality services



XDC high level architecture



+ Project Status

- XDC started on the 1st of November
- First month used to set up the human resources, the management structure and administration stuff
- Project kick-off 23-25 Jan 2018 in Bologna, Italy (joint with DEEP-HybridCloud)
- Now collecting the internal communities requirements for new functionalities (PM3)
- General architecture deliverables on PM6 and PM7 (mid 2018)
- Contacts: info@extreme-datacloud.eu, extreme-datacloud.eu (site under construction)