Co-funded by the Horizon 2020
Framework Programme of the European Union
Grant Agreement Number 825532

Large-scale EXecution for Industry & Society

LEXIS

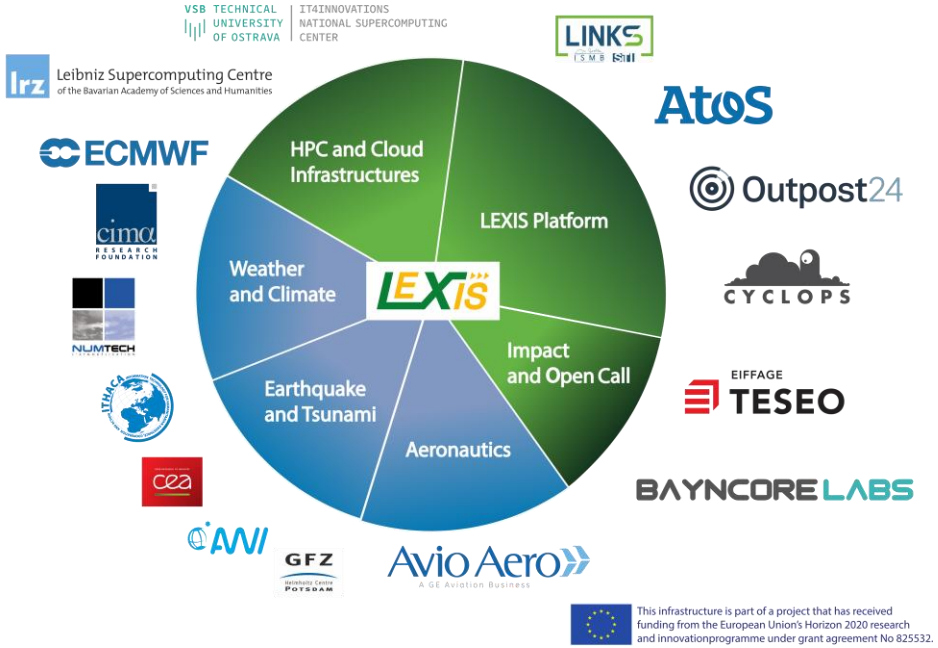
www.lexis-project.eu

FEDERATED RESEARCH DATA MANAGEMENT *IN LEXIS*

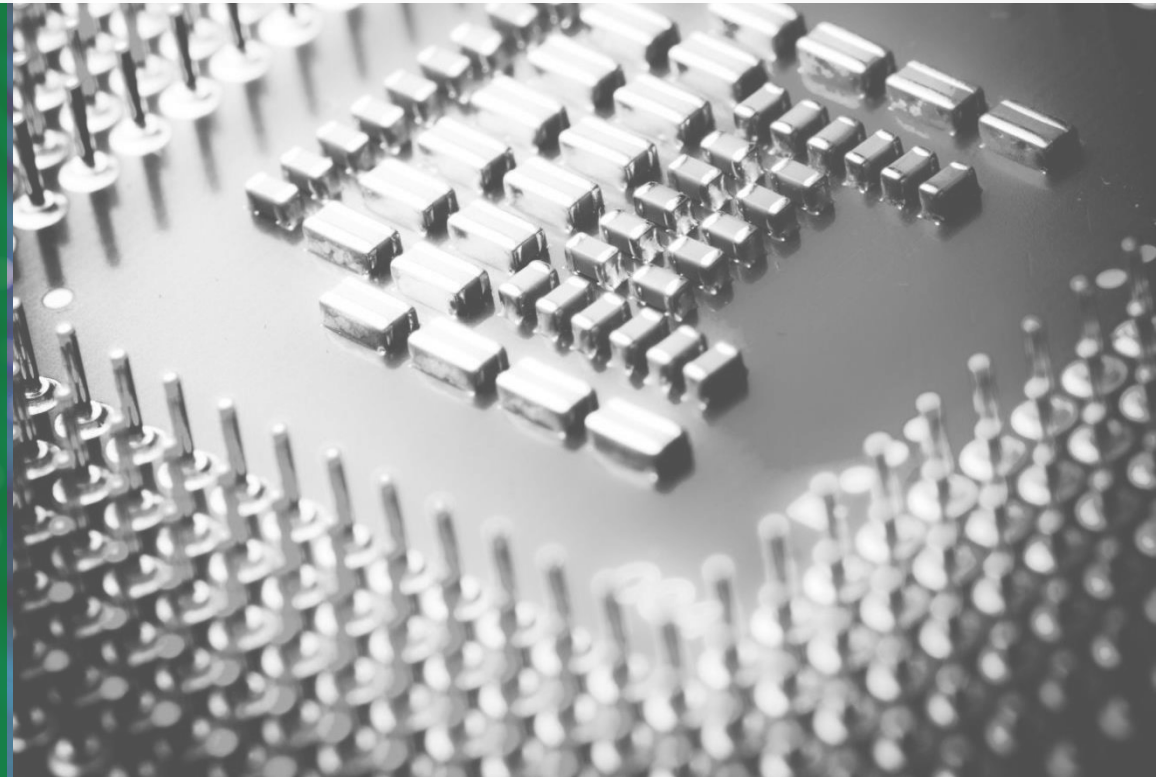
EGI 2020 Conference
Nov 2nd, 2020
Data Management Solutions - Part 1

JOHANNES MUNKE, MOHAMAD HAYEK
(LRZ)

WITH LEXIS DATA SYSTEM TEAM AND CONSORTIUM



CONTEXT: QUICK OVERVIEW OF LEXIS



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Topic:	HPC and Big Data enabled Large-scale Test-beds and Applications
Topic identifier:	ICT-11-2018-2019
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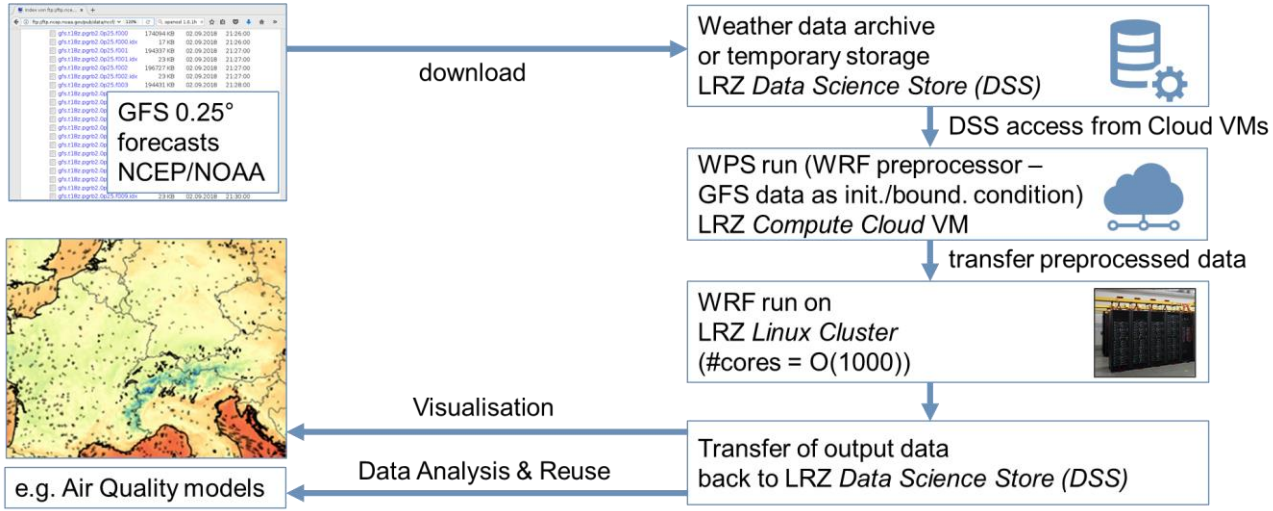
LEXIS project, led by the IT4Innovations (CZ) Supercomputing Centre:

(…) is building an advanced engineering platform at the confluence of **HPC, Cloud and Big Data, which leverages large-scale geographically-distributed resources** from existing HPC infrastructure, employs Big Data analytics solutions and augments them with Cloud services.

Driven by the requirements of several pilot testcases, the LEXIS platform relies on best-in-class **data management solutions** (EUDAT) and **advanced, distributed orchestration solutions** (TOSCA), augmenting them with new, efficient hardware and platform capabilities (e.g. in the form of **Data Nodes and federation**, usage **monitoring and accounting/billing support).**
Thus realize, LEXIS realises an innovative solution (…)

LEXIS: THE PROBLEM ADDRESSED

- Typical High-Performance-Computing (HPC) / Big Data workflow: Weather prediction at LRZ



LEXIS: THE PROBLEM ADDRESSED

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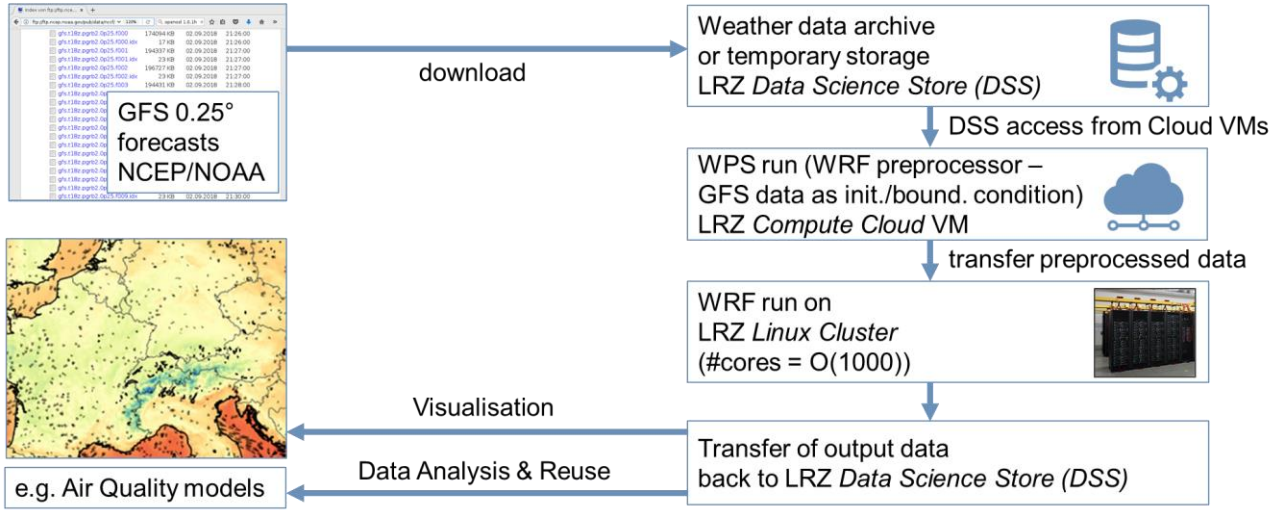


- Complicated!
  - multiple systems & data transfers to be set up
  - closed system, no flexible usage of European resources
- Not often leveraged by Industry, SMEs, unexperienced scientists

LEXIS H2020 PROJECT OBJECTIVES

European Computing & Big Data Platform for Industry, Society, Science

- **Access to the HPC/Cloud/Big Data** resources for **SMEs/Industry** (incl. Billing model)
- **Web Portal** (easy entry point, unified AAI)
- **Orchestration** for easy, automatic and optimized workflows
  - **Cloud and HPC** resources at **different European Computing Sites**
  - convenient **user interface** to **define workflows**
  - boosted by **acceleration techniques** (Compute: GPU, FPGA; Data: Burst Buffers)

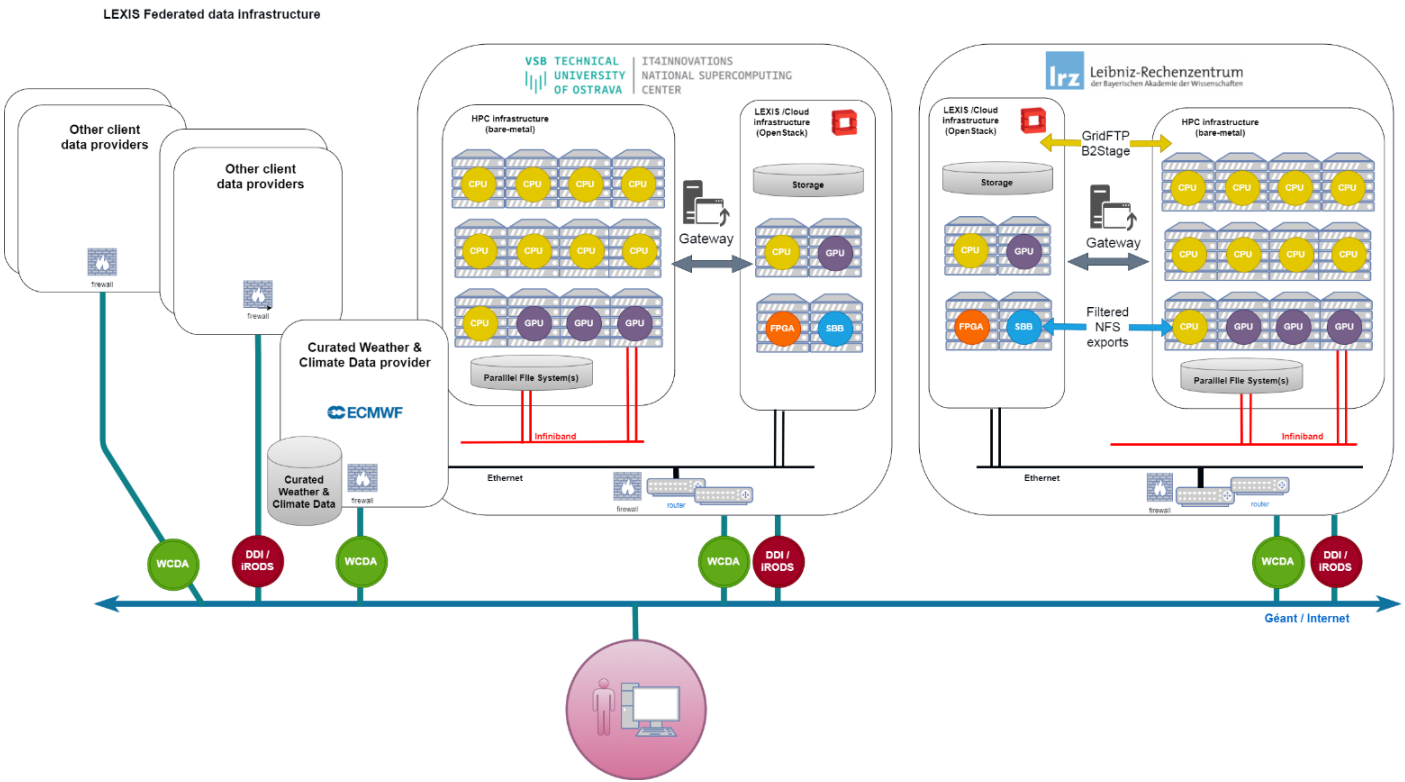
→ Details in the talk of **Alberto Scionti** et al., 13:15 today, session **„Workflow Management Solutions“**

- **Integration with European Infrastructure**

- **Demand** for a **strong Data Management backend** – LEXIS Work Package 3
  - **unified data access** from LEXIS **Cloud and HPC resources across Europe**
  - **cross-site “Big Data” and metadata management**
  - Data Discovery and **FAIR (“Findable, Accessible, Interoperable, Reusable”) Data**

→ This is the scope of this talk

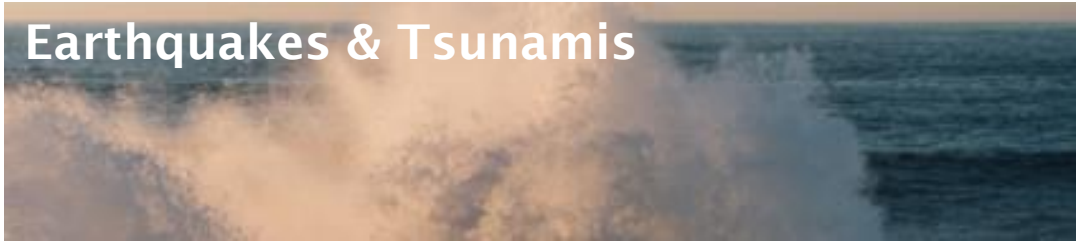
LEXIS PLATFORM



LEXIS PILOT PROJECTS

General information - https://lexis-project.eu/web/

Computation Fluid Dynamics (CFD), Rotating parts (gearboxes), 3D Visualization

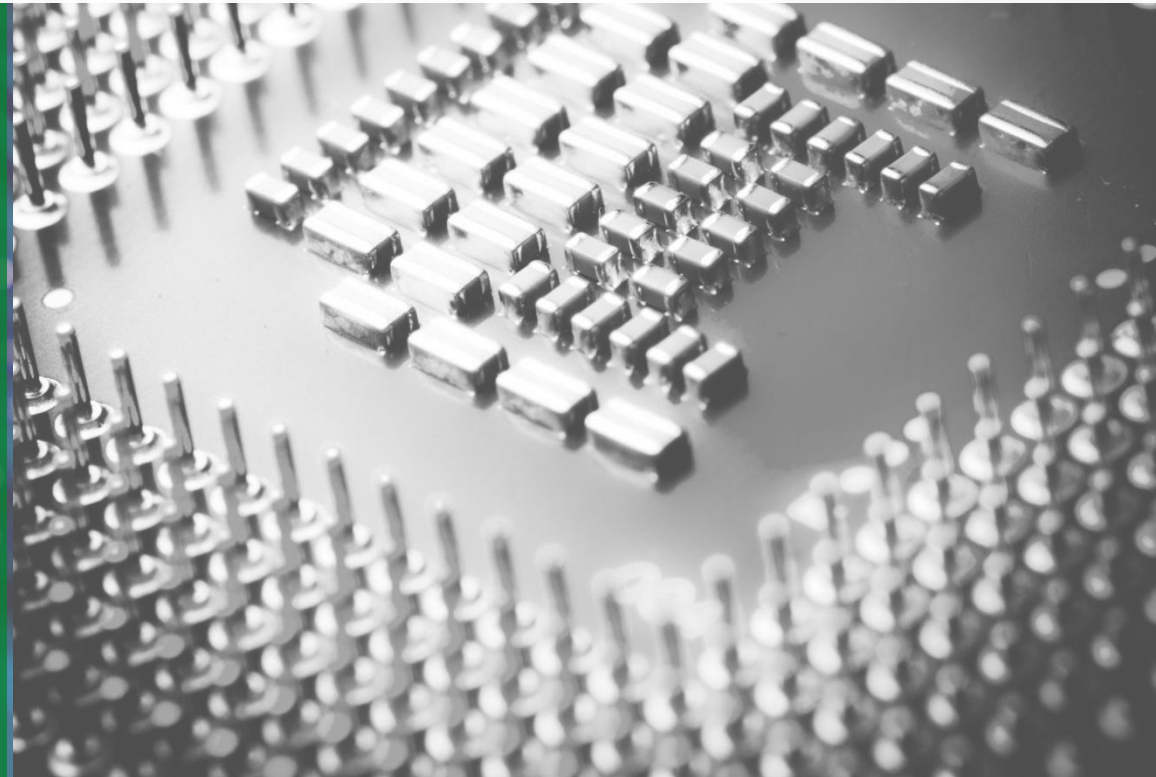


Earthquakes & Tsunami prediction models, geographic and urban databases, emergency organization, urgent computing

Weather & Climate models (WRF) and various post-processors for flood, wildfire & agriculture applications

LEXIS DATA SYSTEM

(WORK PACKAGE 3)



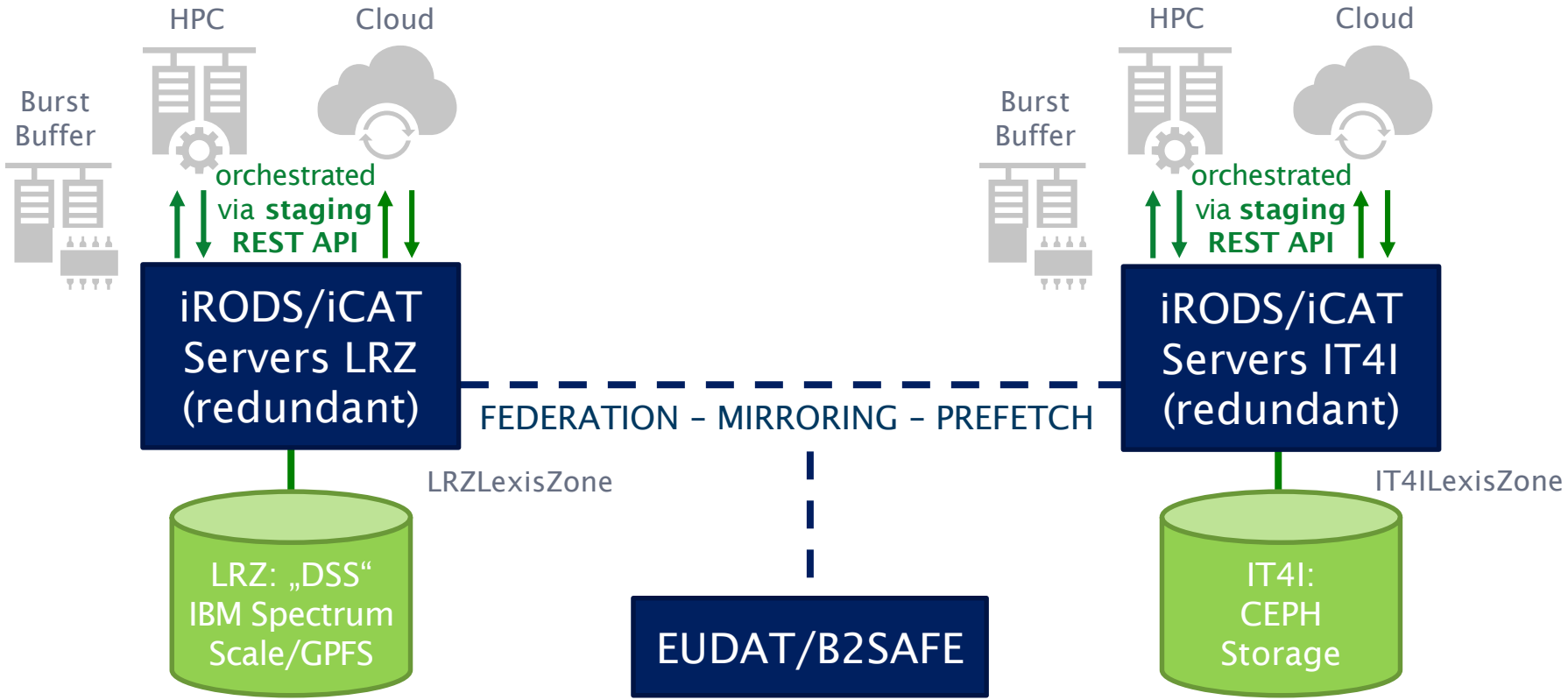
LEXIS DDI - DISTRIBUTED DATA INFRASTRUCTURE

Key Points

- Idea: use an **European system for LEXIS data**
  → **EUDAT/iRODS** (**I**ntegrated **R**ule-**O**riented **D**ata **S**ystem middleware)
- **Unified view on data** in LEXIS – federated **iRODS** zones (IT4I, LRZ, …)
  - **“filesystem-like”;** top-level directories e.g. `/IT4ILexisZone`
  - transparent **access to all files via all iRODS servers**
- Physical file storage policies implemented as **iRODS rules, e.g.**
  - **cross-site mirroring**
  - **low-level storage tiering** (in each computing/data centre)
- **“Non-invasive” data-curation** approach
  - **DataCite-like** metadata stored in iRODS, **EUDAT-B2HANDLE PIDs**
  - directory/access-rights structure fixed on project (top-)level
- Uses **LEXIS cross-provider AAI**

LEXIS DDI

Federation leveraging iRODS & EUDAT B2SAFE (and B2HANDLE, B2STAGE)



DATA PRESERVATION IN LEXIS: B2SAFE

B2SAFE is the data preservation module in EUDAT

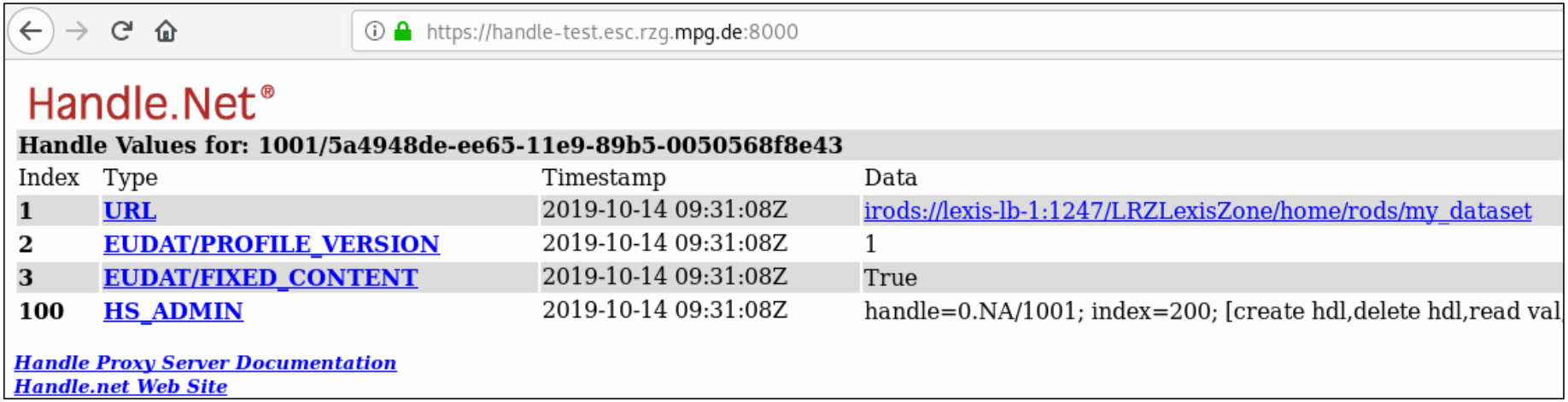
- The B2SAFE service runs on top of LEXIS iRODS zone to:
  - provide data safety and resiliency in case of an issue at one of the federated centres, by implementing mirroring policies;
  - optimize the workflows execution by allowing the Orchestrator to get the data from the zone close to the computing resources; and to
  - trigger PID registration.

EUDAT Collaborative Data Infrastructure, "B2SAFE - EUDAT," EUDAT Ltd, 2020. [Online]. Available: https://www.eudat.eu/services/b2safe.

PERSISTENT IDENTIFIERS IN LEXIS (PIDs): B2HANDLE

B2HANDLE is the PID module in EUDAT

- The LEXIS DDI makes use of B2HANDLE PIDs to guarantee data access via long-lasting unique identifiers, in order to to
  - facilitate publication of data; and
  - facilitate data retrieval in the long term.



THE LEXIS DDI PROMOTES FAIR DATA MANAGEMENT

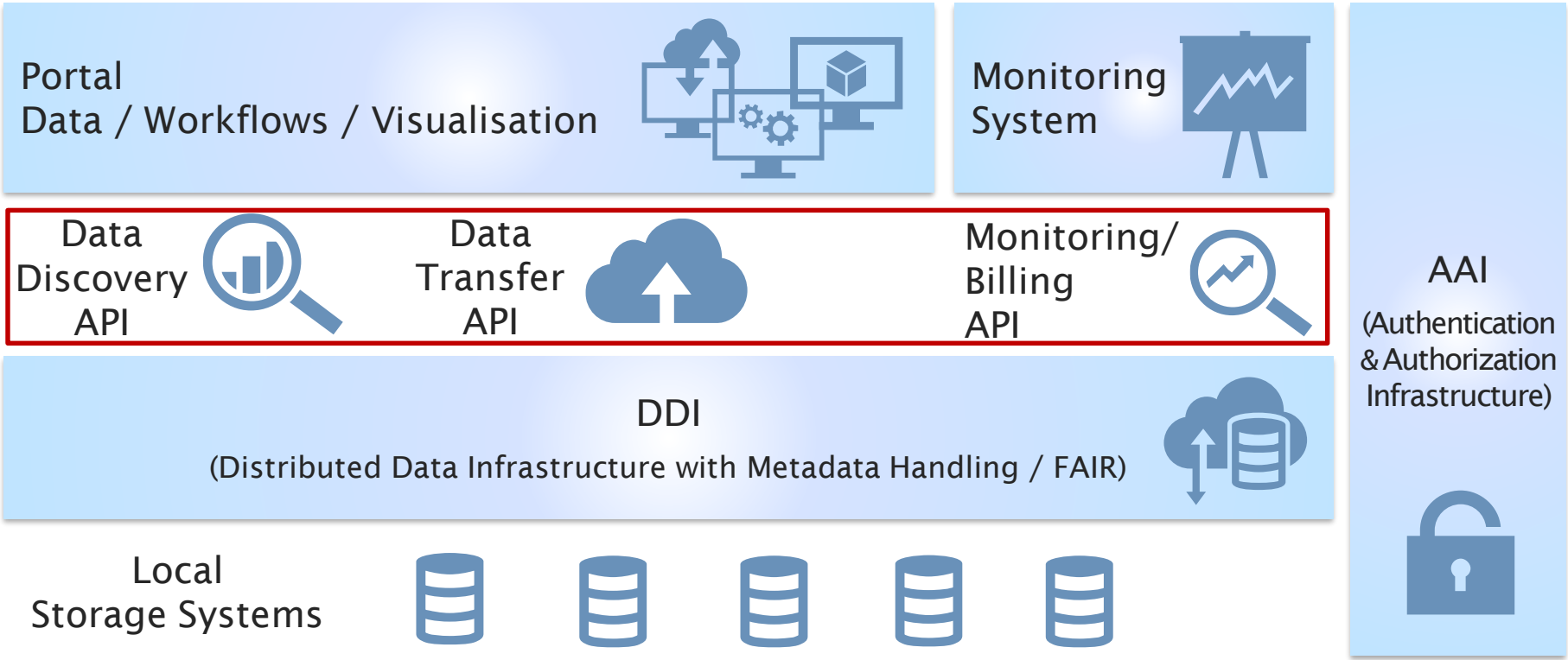
Findable, Accessible, Interoperable, Reusable Research Data

- Two of the most basic FAIR requirements:
  - metadata
  - a (world-)unique identifier for the data
- Metadata in LEXIS:
  - stored in iRODS Attribute-Value(-Unit) store for each data set
  - schema oriented at the basics from DataCite (schema.datacite.org)

```
      @lexis-lb-1:~$ ils
/LRZLexisZone/home/rods/my_dataset:
      @lexis-lb-1:~$ iput opensearch.txt
      @lexis-lb-1:~$ ils
/LRZLexisZone/home/rods/my_dataset:
  opensearch.txt
      @lexis-lb-1:~$ irule -F eudatPidsColl.r
*newPID = 1001/5a4948de-ee65-11e9-89b5-0050568f8e43
      @lexis-lb-1:~$ imeta ls -C /LRZLexisZone/home/rods/my_dataset
AVUs defined for collection /LRZLexisZone/home/rods/my_dataset:
attribute: EUDAT/FIXED_CONTENT
value: True
units:
----
attribute: PID
value: 1001/5a4948de-ee65-11e9-89b5-0050568f8e43
units:
```

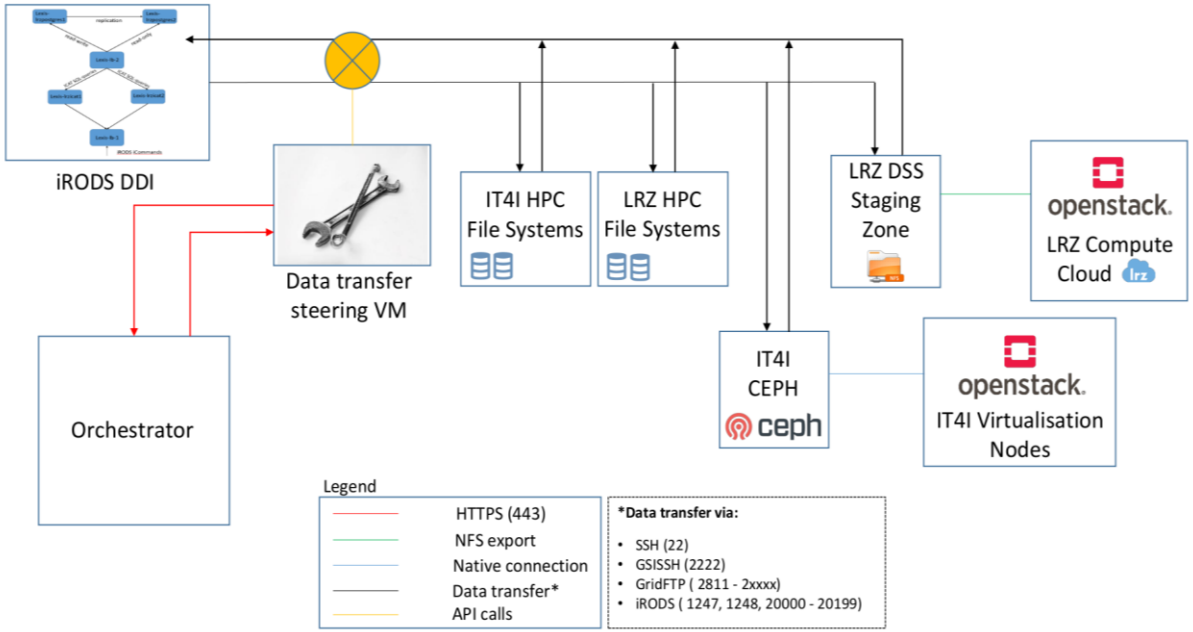
THE DDI IN THE LEXIS ECOSYSTEM

Communication via APIs



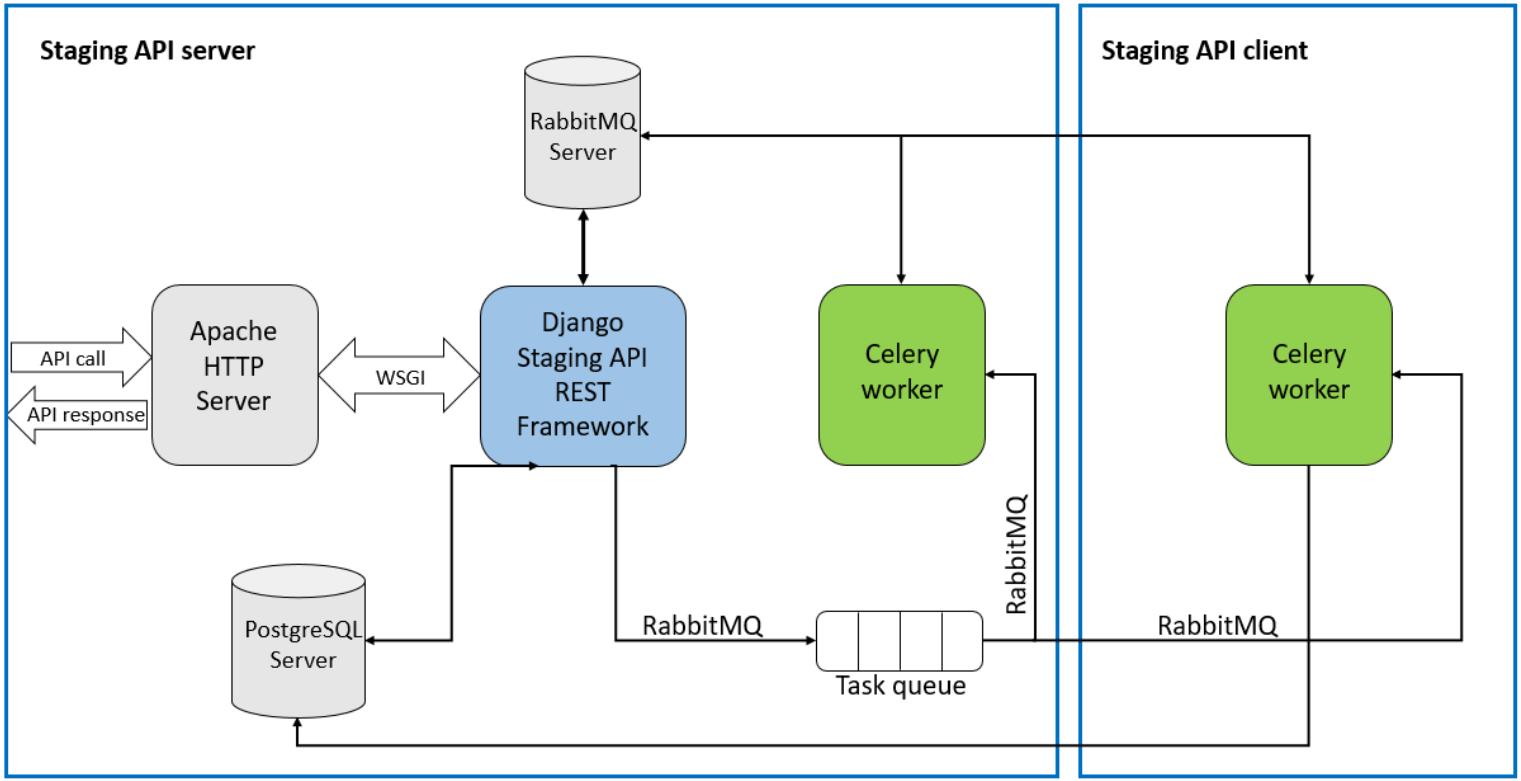
LEXIS DATA SYSTEM APIs: TRANSFER/STAGING API

- Django-based RESTful API
- Purpose: LEXIS orchestrator can move data between the DDI and distributed computing resources by a simple HTTP request.
- Uses LEXIS AAI and the HEAppE middleware to authenticate the requests and authorize access.
- Uses Celery and RabbitMQ to handle requests asynchronously.



LEXIS DATA TRANSFER/STAGING API *(continued)*

Architecture



DATA MANAGEMENT VIA LEXIS PORTAL

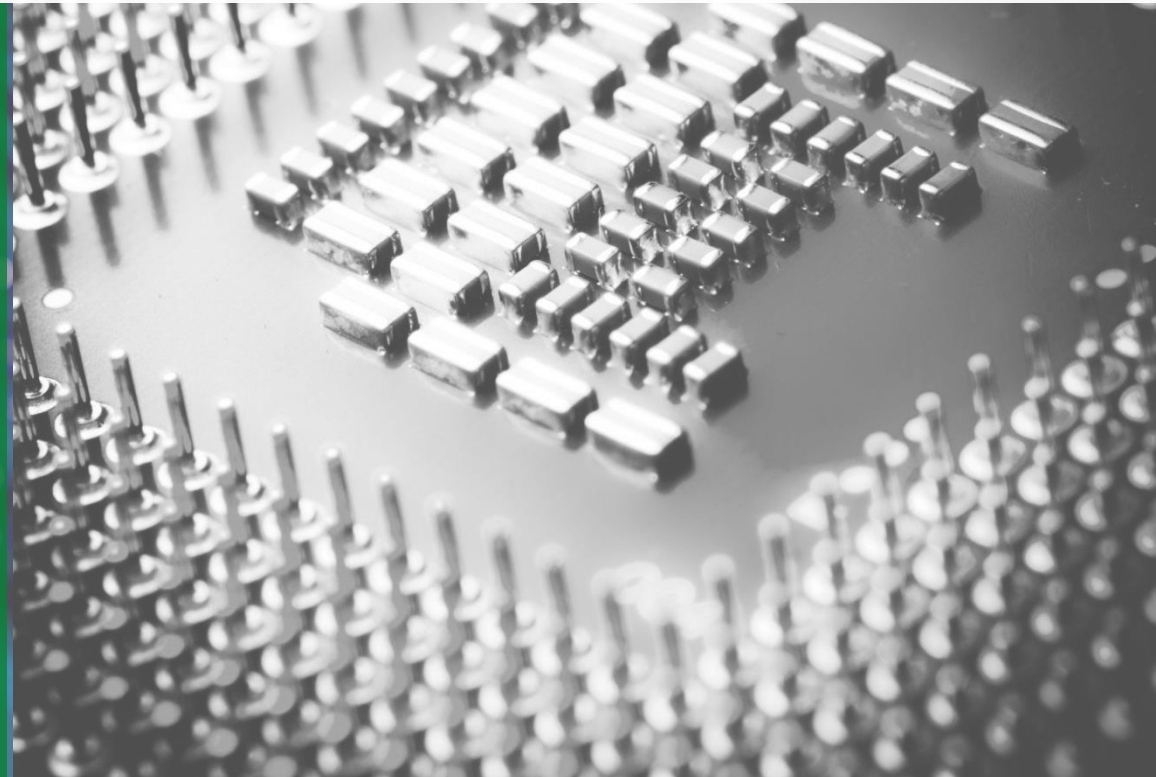
Work Package 8, Task 8.1 – "Work in Progress"

- Login using LEXIS AAI (Keycloak-based)
- User accesses DDI data with rights encoded in token:

  LEXIS DDI validates token using strongly customized iRODS-OpenID Plugin.
- Next months:

  from working demonstrator to
  convenient everyday data management!

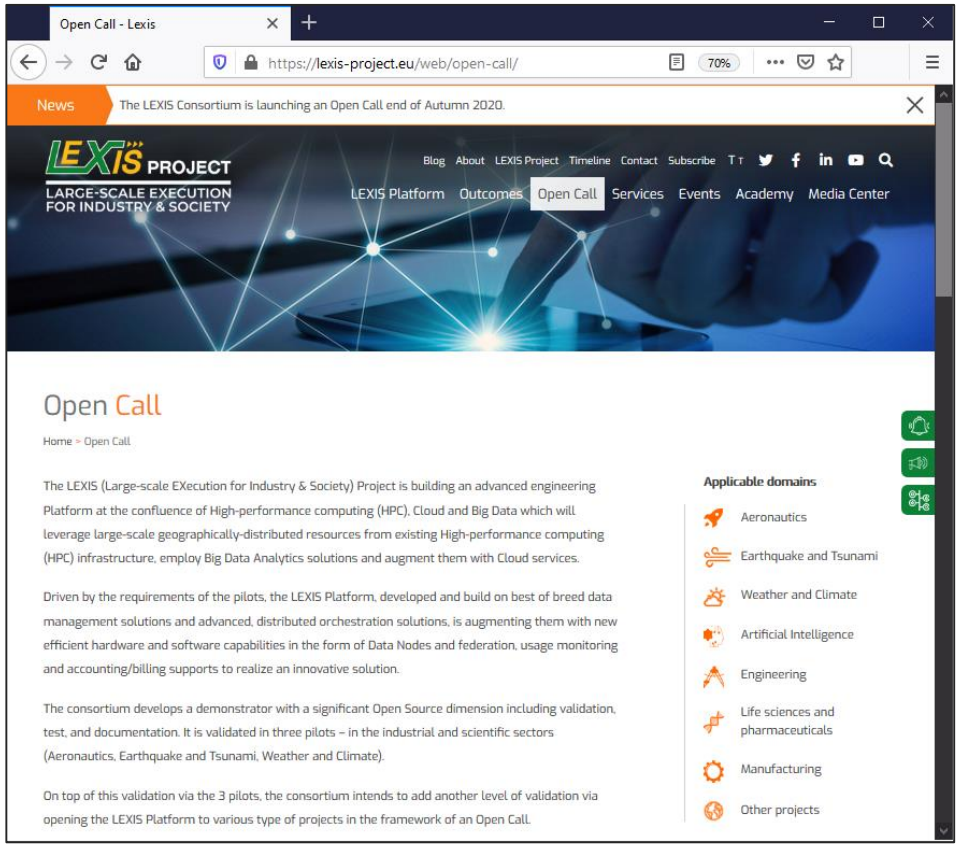
LEXIS OPEN CALL, EUROPEAN COLLABORATION & OUTLOOK



LEXIS – OPEN CALL: OBJECTIVES

- Idea: additional validation of platform via various “external” use cases
- Selected Open Call projects have the opportunity to
  - access HPC/Cloud workflow orchestration & data platform with large resources, and
  - get technical support and training (individual "project manager" from LEXIS team).
- These projects also include other EU projects (e.g. CompBioMed2) → collaboration
- **Current stage**: Further applicants are submitting their projects and the Open Call Board will select the best ones
  - larger focus on Industry / Private sector (but not exclusive)
  - collaboration & integration with European & third party infrastructures (Computing/Data)

LEXIS – OPEN CALL ON PROJECT WEBSITE



For further information and registration visit:

lexis-project.eu/web/open-call/

CONCLUSIONS AND OUTLOOK

- LEXIS **European Cloud-HPC Workflow Platform** (H2020) works with a **Distributed Data Infrastructure** based on **iRODS/EUDAT-B2SAFE**
- Philosophy: **Easy usability** via Portal, **clean architecture** (REST APIs…)
- **Data Federation** of IT4I (CZ) and LRZ (DE) to be extended to **further participants**
- Platform to be further **immersed with EUDAT and beyond** (ideas: BDVA, EGI federated cloud, EOSC, …)
- We are aiming at (and **open** for) **collaborations**!
  - with centres joining the LEXIS platform
  - with EU projects and initiatives

  … in the frame of the **LEXIS Open Call and in general.**
- Focus in 2021: benchmarking, optimisation & sustainability of the platform (operation & funding model, etc.)

CONTACT

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Thanks for your attention!

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