

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

Large-scale EXecution for Industry & Society

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HPC-CLOUD-BIG DATA CONVERGENT ARCHITECTURES + RESEARCH DATA MANAGEMENT: THE LEXIS APPROACH

ISGC 2021, TAIPEI, 2021-03-25

FOR THE LEXIS & LEXIS-WP3 TEAM: STEPHAN HACHINGER LEXIS WP3 (data) lead LEIBNIZ SUPERCOMPUTING CENTRE (LRZ)



ABOUT LEXIS



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Торі	c: HPC and Big Data enabled Large-scale Test-beds and Applications
Торі	c identifier: ICT-11-2018-2019
Турє	LEXIS project, led by Jan Martinovič, IT4I Supercomputing Center:
Scop	LEXIS project will build an advanced engineering platform at the confluence of HPC , Cloud and Big Data which will leverage large-scale geographically distributed resources from existing HPC infrastructure, employ Big Data analytics solutions and augment them with Cloud services.
Proj∉ Bud <u>¢</u> EC C Partı Proj€	Driven by the requirements of the pilots, the LEXIS platform will build on best of breed data management solutions (EUDAT) and advanced distributed orchestration solutions (TOSCA), augmenting them with new efficient hardware capabilities in the form of Data Nodes and federation, usage monitoring and accounting/billing supports to realize an innovative solution.

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KEY POINTS OF LEXIS PLATFORM

- Dynamic, complex Cloud- & High-Performance-Computing / Big Data workflows
 - orchestration in geographical federation with YORC, HEAppE
 - real-time deadline-aware workflows, etc.
- Cross-site (meta-)data federation
 - distributed data management and data discovery with *EUDAT/iRODS*
 - data transfers accelerated by Burst Buffer nodes; FPGAs/GPUs for on-line processing
- Web portal and interfaces for workflow set-up / execution
 - unified access to all services via *keycloak*-based LEXIS AAI
- Easy HPC/Cloud access for SMEs/Industry Big Data for everyone
 - HPC-as-a-Service approach
 - control over resource usage
 - fine-grained accounting and billing for multiple HPC centres with *CYCLOPS*





LEXIS PILOT PROJECTS

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



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



PLATFORM AND ORCHESTRATION

USER EXPERIENCE

LEXIS portal





LEXIS INFRASTRUCTURE OVERVIEW



LEXIS ORCHESTRATION CONCEPT

HEAppE middleware + YORC (Ystia Orchestrator, based on TOSCA) + Alien4Cloud User Interface

From system to UI level:

- **HEAppE:** middleware for unified HPC and Cloud access
- **Yorc:** orchestration service backend, executes application workflows
- Alien4Cloud: orchestration service frontend:
 - Catalogue for storing workflow application templates and components
 - UI for defining new workflows
 - Client library + REST API



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ORCHESTRATION SERVICE

Workflow deployment

- Execution on (geographically distributed) HPC and Cloud resources
 - **Cloud:** via OpenStack built-in interface
 - HPC: job execution is mediated by HEAppE middleware
- Data management and orchestration policies
 - Leverage the LEXIS DDI service for an effective data transfer between systems
 - Placement of **workflow tasks** on the most suitable resource



TERMINOLOGY – USER VIEW VS. TECHNOLOGY VIEW





LEXIS DATA SYSTEM (DISTRIBUTED DATA INFRASTRUCTURE – DDI)

LEXIS DISTRIBUTED DATA INFRASTRUCTURE

Functionality in LEXIS ecosystem



LEXIS DISTRIBUTED DATA INFRASTRUCTURE

Backend functionality in more detail



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INTEGRATION WITH EUDAT: B2HANDLE

- We equip data with EUDAT-B2HANDLE PIDs, based (as DOIs) on the Handle System (IETF RFCs 3650/51/52)
- Aim: long lasting references in
 - data management (B2SAFE)
 - search (B2FIND...), and
 - publication

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i https://handle-test.esc.rzg.mpg.de:8000

Handle.Net®

Handle Values for: 1001/5a4948de-ee65-11e9-89b5-0050568f8e43

Index	Туре	Timestamp	Data
1	URL	2019-10-14 09:31:08Z	irods://lexis-lb-1:1247/LRZLexisZone/home/rods/my_dataset
2	EUDAT/PROFILE_VERSION	2019-10-14 09:31:08Z	1
3	EUDAT/FIXED_CONTENT	2019-10-14 09:31:08Z	True
100	HS_ADMIN	2019-10-14 09:31:08Z	handle=0.NA/1001; index=200; [create hdl,delete hdl,read val

<u>Handle Proxy Server Documentation</u> <u>Handle.net Web Site</u>

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LEXIS INTEGRATION WITH REST APIS: STAGING API

Overview of the Staging API

Endpoint	Method	Request body	Response body
/stage	POST	{ "source_system" : "Irz_iRODS", "source_path": "public/testruben/dataset-16168", "target_system": "Irz_staging_area", "target_path": "DDIStaging/dataset- 161684" }	{ "request_id": "cc19e4a8-e4cf-4bca-bf7a- 2bc9a27c44d6" }
/stage/ <request_id></request_id>	GET	-	{ "status": "Transfer completed" }or { "status": "In progress" }
/delete	DELETE	{ "target_system": "Irz_staging_area", "target_path":"DDIStaging/dataset- 161683" }	{ "request_id": "cc19e4a8-e4cf-4bca- bf7a-2bc9a27c44d6" }
/delete/ <request_id></request_id>	GET	-	{ "status": "Data deleted" }or { "status": "In progress" }



BEHIND THE SCENES: LEXIS STAGING API

System View

- LEXIS orchestrator can move data by simple HTTP request
 - between iRODS,
 - Cloud, and
 - HPC resources at all LEXIS centers.
- Uses LEXIS AAI and the HEAppE middleware
- Queuing system using Celery and RabbitMQ handles requests asynchronously.





THE FAIR SIDE OF LEXIS: METADATA, PIDS

Findable, Accessible, Interoperable, Reuseable Research Data

- Most basic FAIR data requirements:
 - metadata
 - (world-)unique dataset identifier
- Metadata in LEXIS:
 - stored in iRODS Attribute-Value(-Unit) store for each data set
 - schema oriented at the basics from DataCite (schema.datacite.org)
- PIDs in LEXIS: B2HANDLE
- Aiming for findability of LEXIS public data sets via EUDAT-B2FIND

```
@lexis-lb-1:~S 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:
```



LEXIS OPEN CALL

LEXIS – OPEN CALL – OBJECTIVES

Objective: work with test users (including SMEs/industry) and various projects to

- validate platform w/r/t
 - technologies developed/deployed,
 - orchestration paradigm,
 - usability of data sets and DDI, and
- refine platform to warrant
 - optimum performance at end of the project, and
 - exploitation post-end-of-project.

Benefit for applicants:

- test HPC/Cloud/Big Data platform with large resources "for free"
- get individual project & tech support + training from LEXIS team





LEXIS

Open Call 2020-2021

LEXIS & OPEN CALL WEBSITE

Have a look on: https://lexis-project.eu/web/open-call !

- 2nd stage running: Free application reviewed by LEXIS Open Call Board
- Platform testing up to Q4/2021



THANKS! CONTACTS:

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CONSORTIUM

