Large-scale EXecution for Industry & Society

Deliverable D8.2

Second Release of LEXIS Portal

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GLOSSARY

ACRONYM	DESCRIPTION
DDI	Distributed Data Infrastructure
HPC	High Performance Computing
API	Application Programming Interface
AAI	Authentication & Authorization Infrastructure
JSON	JavaScript Object Notation
A4C	Alien4Cloud
HEAPPE	High-End Application Execution
GUI	Graphical User Interface

TABLE OF PARTNERS

ACRONYM	PARTNER
Avio Aero	GE AVIO SRL
Atos	BULL SAS
AWI	ALFRED WEGENER INSTITUT HELMHOLTZ ZENTRUM FUR POLAR UND MEERESFORSCHUNG
BLABS	BAYNCORE LABS LIMITED
CEA	COMMISSARIAT A L ENERGIE ATOMIQUE ET AUX ENERGIES ALTERNATIVES
CIMA	CENTRO INTERNAZIONALE IN MONITORAGGIO AMBIENTALE - FONDAZIONE CIMA
CYC	CYCLOPS LABS GMBH
ECMWF	EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS
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GFZ	HELMHOLTZ ZENTRUM POTSDAM DEUTSCHESGEOFORSCHUNGSZENTRUM GFZ
ICHEC	NATIONAL UNIVERSITY OF IRELAND GALWAY / Irish Centre for High-End Computing
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ITHACA	ASSOCIAZIONE ITHACA
LINKS	FONDAZIONE LINKS / ISTITUTO SUPERIORE MARIO BOELLA ISMB
LRZ	BAYERISCHE AKADEMIE DER WISSENSCHAFTEN / Leibniz Rechenzentrum der BAdW
NUM	NUMTECH
O24	OUTPOST 24 FRANCE
TESEO	TESEO SPA TECNOLOGIE E SISTEMI ELETTRONICI ED OTTICI

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EXECUTIVE SUMMARY

An important aspect of the LEXIS project is to make easy access to the LEXIS platform. We are making this possible by the following two things:

- graphical user interface,
- common APIs to the LEXIS services.

The LEXIS Portal is covering the graphical part and it also provides APIs which can be used to integrate its capabilities into another systems.

Position of the deliverable in the whole project context

The deliverable showcases the state of progress on Task 8.1, Task 8.2 and Task 8.3, which provide access to datasets, monitoring, accounting, and billing. Synergies between WP8 on one side and WP2, WP3, WP4 on the other side ensure that the APIs provide the information needed for final users. The deliverable is related to other LEXIS deliverables as follows: Deliverable D2.4 [1] which describes the overall LEXIS architecture, Deliverable D4.5 [2], and Deliverable D4.7 [3] which describe the AAI model developed for LEXIS.

This deliverable is an update of Deliverable D8.1 [4] and will be followed by Deliverable D8.3 [5] which will describe the final release of the LEXIS Portal.

Description of the deliverable

The deliverable describes development updates that were made to individual components of the LEXIS Portal since the release 2 described in Deliverable D8.1 [4]. Additionally, a video showcasing the LEXIS Portal is provided at LEXIS YouTube channel[1], the user documentation is available at LEXIS project public documentation[2], and the public source codes are available at LEXIS GitHub project[3]. The user documentation will be amended as additional features are implemented.

The chapters in this deliverable are similar to the Deliverable D8.1 [4], but they are listing only updates of the respective chapters and the screenshots and mock-ups are not used, since the video showcases the LEXIS Portal GUI. As such, the chapters are Introduction, Portal Architecture Update, Components and Integration Update, LEXIS Portal Deployment Update, and Summary and Next Steps.

The contributors to the deliverable were primarily those responsible for the development of the software components and the design and configuration of the AAI system. These are as follows:

- Reactive Front End (IT4I),
- User and organization management service and portal API, integration with accounting and billing functions (CYC),
- Dataset management interface (LRZ),
- Orchestration integration (ICHEC),
- Configuration of AAI for development and test (O24).

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[1] LEXIS YouTube channel: https://www.youtube.com/channel/UCiU3w-dw9-eaOCD4Zlf8qVw
[2] LEXIS project public documentation: https://docs.lexis.tech/
[3] LEXIS GitHub project: https://github.com/lexis-project

1 INTRODUCTION

LEXIS WP8 is focused on developing a Portal to reduce friction when accessing HPC resources both for pilots within the project as well as third parties (LEXIS Open Call [6] participants during the project and other subjects like SMEs, industry or academia after the project). This deliverable is the second deliverable from WP8 which comprises of a software release - a tagged version of the software in the LEXIS repository, user documentation, and running portal.

The LEXIS Portal comprises of four distinct releases[4] R1, R2, R3, R4 - each with increasing levels of capability/functionality. R1 and R2 were initial releases tied to Deliverable D8.1. R3 is the focus of this deliverable and R4 will be delivered in M36. Additional content to this deliverable is the video demonstrators at LEXIS YouTube channel, the documentation at LEXIS project public documentation, and the public repository with public source codes at LEXIS GitHub project. All of these will be updated as the new features will be implemented.

1.1 PURPOSE OF THE LEXIS PORTAL

The LEXIS Portal is an open portal which will provide access to distributed HPC/Cloud resources to support operations relevant to users (from SMEs/Industry/Academia) of such services. The primary function is to make easy interaction with the LEXIS platform through a GUI interface; enabling users to work with big data sets, create and deploy jobs, and see the results of the jobs. Also, the portal will allow project administrators to set the users' rights, ask for the resources at individual centres, and get billing reports. Users will be able to see available datasets, upload their own datasets, and execute jobs based upon LEXIS workflows available to their projects. The full list of the portal functions was presented in the Deliverable D8.1 [4].

1.2 STRUCTURE OF THIS DOCUMENT

This document is structured as follows. Section 2 provides a high-level view of the current LEXIS Portal design, highlighting the main architectural components, their respective functionalities, and their interfaces. Section 3 describes updates made to the portal components since their first introduction in Deliverable D8.1 [4]. Section 4 provides updates of the deployment process of the portal. Section 5 provides a summary of the current state of the development of the LEXIS Portal and identifies the next steps in the development process.

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[4] Note: three distinct releases were defined in the Grant Agreement; it was decided to have an earlier internal release to address integration problems early.

2   LEXIS PORTAL ARCHITECTURE UPDATE

The Portal architecture had evolved into a more robust design since M15 and it is presented in the complete LEXIS architecture diagram in Deliverable D2.4 [1], the actual state comprises the following components:

- The LEXIS Portal Front End: this is a rich React based Front End that interacts with the LEXIS Portal Back End Server (LEXIS Portal BE) and other services via the LEXIS Portal API,
- The LEXIS Portal BE: this is a simple micro-service that serves the Front End content and obtains a token from Keycloak,
- The LEXIS Portal API: this is the main entry point by which the Front End can access functionality offered by the LEXIS Platform Modules. A valid token sanctioned by Keycloak is necessary to access any functionality offered by the Portal API,
- The LEXIS User-Org Service: this is a service which handles the creation and management of users, organizations, projects, and HPC Resources as defined within the system. The data is persisted in the database (DB).
- The LEXIS Alien4Cloud interface: this service performs interaction with Alien4Cloud to support the definition of LEXIS Workflows and deployment of LEXIS Jobs,
- The LEXIS Data Management Interface: this service supports interaction with the DDI to support listings of directories on the DDI and uploading and downloading files to and from the DDI,
- The Approval System Interface: this service supports the interaction with the HEAppE Approval Service, which handles the request and approval of HPC resources linked to LEXIS projects.

3   LEXIS PORTAL COMPONENTS AND INTEGRATIONS UPDATE

3.1   LEXIS PORTAL API

Since the LEXIS Portal API behaves as a proxy to all the other services to keep them as a unified interface and protected, the endpoints that are exposed in the Portal API have been growing to be in sync with all the functionality exposed by the rest of the interfaces/services in actual use by the LEXIS Portal.

It should be mentioned that in this version of the LEXIS Portal API, and all the services that work behind it, beside the enforcement of the Keycloak token in order to use the endpoint, the whole security/authorization model has been upgraded to include endpoint policies and role-base access control.

3.2   LEXIS USER-ORG SERVICE

During the process of getting ready for the LEXIS Pilots and the LEXIS Open Call, different use-cases have been analysed and as a by-product of it, we have been able to uncover some missing pieces needed to achieve completeness in our solution, hence, the data-models and endpoints used by the LEXIS Portal that are controlled by the User-Org Service were re-factored into a more simple but complete form.

3.3   LEXIS DATA MANAGEMENT INTERFACE SERVICE

During the last year, we have evolved the APIs of the Data Management Interface to enhance ease-of-use. The number of staging zones has increased, and remote zones are now supported. The queueing system has also been re-designed. Some APIs were modified to enable the integration with HEAppE. A B2SAFE API was added, and EUDAT metadata (PIDs, replication metadata) is now exposed.

Data upload and download was made more user-friendly by the addition of TUS endpoints[5] and download via creation of a multi-part archive. Access to datasets via EUDAT / B2STAGE / GridFTP is mediated via a new API call.

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[5] TUS endpoints: https://tus.io/

Access to the cloud staging area now uses SSHFS, enabled via a new API. User-defined metadata (including schema validation) and rights management metadata were added.

In iRODS itself, the project names are now md5-hashed to avoid accidental exposure of project names. We updated iRODS from 4.2.3 to 4.2.8 (including updates to the required dependencies needed for the connection to OpenID/Keycloak.

3.4 LEXIS ALIEN4CLOUD INTERFACE SERVICE

The logic translating LEXIS Workflows and Workflow Executions to A4C Applications and concepts has changed. LEXIS Workflows are now a Portal 'Internal' resource/operation and are tracked by the portal in a DB table. When a LEXIS Workflow Execution is created only then is a A4C Application created, deployed and the A4C 'Run' workflow is ran. These are again tracked by the portal in a DB table. This was implemented to allow for asynchronous execution of LEXIS Workflow Executions, due to A4C limited capabilities in running A4C Workflows in parallel for a single A4C Application.

Data type handling has been extended, AAI has been added to endpoints, as well as appropriate resource filtering. A progress graph has been developed; execution location has been added.

3.5 LEXIS AAI CONFIGURATION

The LEXIS AAI relies on the open source identity and access management solution Keycloak deployed in a cross datacentre replication mode. The LEXIS AAI has been described in details in Deliverable D4.5 [2].

Keycloak has been configured with a dedicated "Keycloak REALM" for the LEXIS Platform that contains several "Keycloak Clients" for each component of the LEXIS Platform.

The "Keycloak Client" for the LEXIS Portal is following a naming convention and is named "LEXIS_PORTAL_SERVICE", see Figure 1. This Keycloak Client is configured to use the openid-connect protocol as "confidential", meaning the LEXIS Portal needs to provide a secret in addition to the client id in order to be authenticated during the API call to Keycloak.

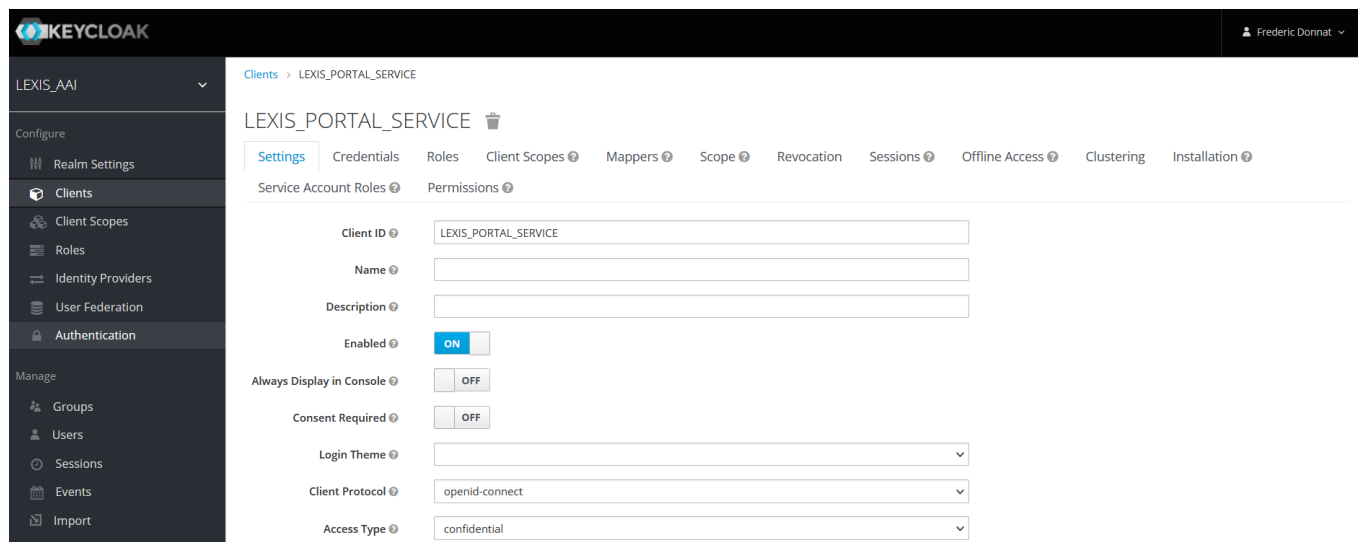**Figure 1 Configuration of the LEXIS Portal Client within Keycloak**

The LEXIS Portal Client in Keycloak also contains "Keycloak Mappers", that allow to map "Keycloak Group" attributes to the user's information that can be retrieved from Keycloak, see Figure 2. Using such mappers allows the LEXIS Portal component to retrieve user's permissions while making an API request to retrieve user information.

This is done in addition to minimizing the information present in an Access Token.

LEXIS_PORTAL_SERVICE 🗑

Settings | Credentials | Roles | Client Scopes ❓ | **Mappers ❓** | Scope ❓ | Revocation | Sessions ❓ | Offline Access ❓ | Clustering | Installation ❓
Service Account Roles ❓ | Permissions ❓

Name	Category	Type	Priority Order	Actions	
Project List Mapper	Token mapper	User Attribute	0	Edit	Delete
Org Read Mapper	Token mapper	User Attribute	0	Edit	Delete
Data Write Mapper	Token mapper	User Attribute	0	Edit	Delete
IAM Read Mapper	Token mapper	User Attribute	0	Edit	Delete
Project Write Mapper	Token mapper	User Attribute	0	Edit	Delete
Data Read Mapper	Token mapper	User Attribute	0	Edit	Delete
IAM List Mapper	Token mapper	User Attribute	0	Edit	Delete
Data List Mapper	Token mapper	User Attribute	0	Edit	Delete
Project Read Mapper	Token mapper	User Attribute	0	Edit	Delete
Org List Mapper	Token mapper	User Attribute	0	Edit	Delete
Org Write Mapper	Token mapper	User Attribute	0	Edit	Delete

(search field: Mapper) [Create] [Add Builtin]

Figure 2 Keycloak Mappers for the LEXIS_PORTAL_SERVICE Client

As an example of such mappers, the "Org List mapper" is the one allowing to describe the permission for a specific user to "list" an organization which is the access to the "public" information of the organization, see Figure 3. Any private information from the organization requires the "read" permission and modifying the organization requires the "write" permission.

Clients > LEXIS_PORTAL_SERVICE > Mappers > Org List Mapper

Org List Mapper 🗑

Field	Value
Protocol ❓	openid-connect
ID	aa87bdc9-2b2d-4287-a935-837f425bf514
Name ❓	Org List Mapper
Mapper Type ❓	User Attribute
User Attribute ❓	ORG_LIST
Token Claim Name ❓	attributes.org_list
Claim JSON Type ❓	JSON
Add to ID token ❓	OFF
Add to access token ❓	OFF
Add to userinfo ❓	ON
Multivalued ❓	ON
Aggregate attribute values ❓	ON

Figure 3 Org List mapper of the LEXIS_PORTAL_SERVICE Client

In order to allow a user to "list" an organization, the LEXIS Portal has to add the user to the specific "Keycloak Group" containing the "list" permission for this organization that is set at the Group attributes level.

Figure 4 shows an example of such a "Keycloak Group".

Groups > ORG_LIST

ORG_LIST 🗑

| Settings | Attributes | Role Mappings | Members | Permissions ❔ |

Key	Value	Actions
ORG_LIST	{"ORG_UUID":"1a29d5d0-ed20-fac0-802e-227ac95231b7"}	Delete
		Add

Save Cancel

Figure 4 Example of a Group attribute providing "list" permission

As mentioned previously, the LEXIS Portal can retrieve the permission for a specific user by calling the userinfo endpoint for its Keycloak Client and this information will be presented using JSON formatting, see Figure 5.


```
"sub": "<SOME_UUID>",
"email_verified": true,
"name": "FDO TEST",
"attributes": {
  "org_list": [
    {
      "ORG_UUID": "<SOME_UUID>"
    }
  ]
},
"preferred_username": "fdo-test",
"given_name": "FDO",
"family_name": "TEST",
"email": "fdo+test@outpost24.com"
```

Figure 5 User information retrieved from calling userinfo endpoint

More detailed information of the implementation of the access control will be presented in Deliverable D4.7 [3].

3.6   LEXIS CYCLOPS INTEGRATION

The Cyclops Billing Engine has been upgraded and re-factored several times since M15 in order to achieve more stability and to make the Credit-System compliant with the needs of the project that have been systematically tracked during the past months in a cross-WPs process.

4 LEXIS PORTAL DEPLOYMENT UPDATE

At the moment of writing the previous deliverable, the process to deploy the LEXIS Portal, was done completely in a manual fashion, which at that time was good enough, but the continuous integration of new functionalities and the upgrade of the interfaces made it a titanic task, so the idea of using a Continuous-Integration and Continuous-Delivery (CI/CD) approach was turned into reality, and bit by bit we have transferred all the manual processes involved into a series of scripts that could handle the whole process.

The last step of this process ended up with the inclusion of the configuration files for the deployments into the CI/CD pipelines upgrading our basic DevOps pipeline into a sort of Configuration-as-Code, thus enabling us to handle the deployment and configurations with a source control repository.

The most complete sample of the script that handles the creation of the docker images and deployment is the one that creates the LEXIS Portal Front End + BE image.

5 SUMMARY AND NEXT STEPS

In release R3 of the portal, most of the components were enhanced in regard to release R2, and the portal deployment was improved to leverage automatic CI/CD tests and deployment. Most of the improvements were related to the enhanced user experience, as these problems were discovered during the preparation of the LEXIS Open Call.

Updates of the architecture and individual components were provided. Another aspect complementing this deliverable are the links to the video demo hosted on LEXIS YouTube channel[6], documentation at LEXIS public documentation[7], and LEXIS GitHub project repository[8] , which will be continuously revised in the following months as more features will be fixed and stable.

For the future steps, the missing features such as self-registration will be finalised, and the LEXIS Open Call will be used as a feedback for the next development activities.

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[6] LEXIS YouTube channel: https://www.youtube.com/channel/UCiU3w-dw9-eaOCD4Zlf8qVw
[7] LEXIS project public documentation: https://docs.lexis.tech/
[8] LEXIS GitHub project: https://github.com/lexis-project

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[2] LEXIS Deliverable, *D4.5 Definition of Mechanisms for Securing Federated Infrastructures.*

[3] LEXIS Deliverable, *D4.7 Centralized AAI: Coverage of All Significant Systems.*

[4] LEXIS Deliverable, *D8.1 First Release of LEXIS Portal (will include report).*

[5] LEXIS Deliverable, *D8.3 Final Release of LEXIS Portal.*

[6] LEXIS Deliverable, *D9.4 Open Call Framework and Stakeholders Engagement on Targeted Large-Scale Pilots - first report.*