Large-scale EXecution for Industry & Society

Deliverable D8.3

Final Release of LEXIS Portal

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0.6	Adding security audit and concerns in several places (section 1, 2 and 5)	22/11/2021	Frédéric Donnat (O24)
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1.0	Final check of the deliverable	28/12/2021	Jan Martinovič, Lukáš Vojáček, Kateřina Slaninová (IT4I)

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
EURAXENT	MARC DERQUENNES
GFZ	HELMHOLTZ ZENTRUM POTSDAM DEUTSCHESGEOFORSCHUNGSZENTRUM GFZ
ICHEC	NATIONAL UNIVERSITY OF IRELAND GALWAY / Irish Centre for High-End Computing
IT4I	VYSOKA SKOLA BANSKA - TECHNICKA UNIVERZITA OSTRAVA / IT4Innovations National Supercomputing Centre
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

TABLE OF CONTENTS

LIST OF FIGURES

EXECUTIVE SUMMARY

An important aspect of the LEXIS project is to provide 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 covers the graphical part and also provides APIs which can be used to integrate its capabilities into another systems.

Position of the deliverable in the whole project context

This 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 setup for LEXIS.

This deliverable is an update of Deliverable D8.2 [4] and provides 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 3 described in Deliverable D8.2 [4]. Additionally, the videos showcasing the LEXIS Portal have been updated to showcase the latest version of the portal (LEXIS YouTube channel[1]), the user documentation at the LEXIS project public documentation[2] has been updated, and the updated public source codes are available at LEXIS GitHub project[3].

The chapters in this deliverable are similar to the Deliverable D8.2 [4], listing the updates of the respective chapters during the project period from M31 to M36. 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 (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/Cloud resources both for pilots within the project as well as third parties (LEXIS Open Call [5] participants during the project and other subjects like SMEs, industry or academia after the project). In particular, security considerations were paramount, and will be described in some detail in this document. This is the third 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 is the outcome 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 [4], R3 was described in D8.2 [6], and R4 is described here. 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, where also code of the portal will be placed (cf. D9.10 [7]). All of these will be updated as the new features will be implemented.

The portal is now available at https://portal.lexis.tech/, and the APIs can be accessed at endpoints located under https://api.lexis.tech/*; see the developer guide[5] for the list of endpoints.

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; 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 Deliverables D8.1 and D8.2 [4].

As a summary the LEXIS Portal is the public-facing web interface for LEXIS users to be able to use LEXIS internal components. As such the Portal is a critical entry point in terms of security, even in the case of a Zero-trust architecture. As a matter of fact, the Portal is the component managing the resources for an organization in the LEXIS Platform, making it fundamental in terms of security.

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 discussion in Deliverables D8.1 and D8.2 [4]. Section 4 provides updates of the deployment process of the portal. Section 5 describes the changes in the React front-end, and Section 6 provides a summary of the current state of the development of the LEXIS Portal.

2 LEXIS PORTAL ARCHITECTURE UPDATE

The Portal architecture has remained stable during project months M31 to M36. We have updated some API endpoints and created some new ones to follow the evolution of the services provided by other work packages; the permission system has been tightened, and the React front-end has been updated to become more user-friendly.

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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.

[5] LEXIS Developer Guide: https://docs.lexis.tech/_pages/portal/developer_guide.html

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 access token retrieved from LEXIS AAI in order to use the endpoint, the whole security/authorization model has been upgraded to include endpoint policies and role-base access control.

The last big change of the LEXIS Portal API Service is related to the Continuous-Integration and Continuous-Delivery (CI/CD) pipeline improvements, the final integration of Cyclops Accounting endpoints, the workflows scheduling, and the polishing of several functionalities which moved the service forward into a fully featured and completed state.

All modules have been reviewed from a security standpoint and security issues have been added to the standard issue development workflow. Special attention has been given to the User-Org service as it is the most critical component (abusing accesses and permissions will result in a full abuse of the LEXIS platform).

3.2 LEXIS USER-ORG SERVICE

Previously, thanks to the analysis of the LEXIS Pilots and the LEXIS Open Call use-cases we were able to identify parts of the system that could be improved with a re-factor of our data models and endpoints, getting the service closer to the architectural expectations of the users. Some of these changes include the possibility to have users interacting with projects from outside their main organization as well as enabling the possibility of being part of multiple organizations thanks to the fine-grain check of the permissions assigned to the users.

In this last iteration, the whole service was revamped in order to achieve the so called completeness, adding the last piece needed, the security of the service now includes a fine-grained control of permissions as well a re-factored data-model which enables the cross-organization and cross-project feature for users, enabling and getting the service ready for future and more complex use-cases that the LEXIS Platform might encounter.

A complete internal security audit on the LEXIS User-Org service has been conducted in order to provide an easy and automated way to verify the global security of the service and to detect incorrect implementation or bugs.

3.3 LEXIS DATA MANAGEMENT INTERFACE SERVICE

Since the last release of the portal, there was a small update in the WP3 DDI API, adding the Duplicate endpoint to ease data replication. The data management interface in WP8 was therefore updated to expose the new endpoint. Small changes to the resumable file upload (tus / The Upload Server[6]) and download endpoints, the documentation and fine tuning of the monitoring was also performed.

3.4 LEXIS ALIEN4CLOUD INTERFACE SERVICE

This iteration of Alien4cloud-interface includes support for the creation and deployment of batches of LEXIS Workflow Executions. As well as this, handling of dataset inputs to LEXIS Workflow Executions has been refined, support for uploading of Workflow Templates to Alien4cloud has been introduced, and an endpoint to delete Workflow Executions has been added.

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[6] tus Open Protocol for Resumable File Uploads: https://tus.io/

3.5   LEXIS AAI CONFIGURATION

The last iteration of the LEXIS AAI deployment and configuration has been described in detail in Deliverable D4.7 Section 2 [3].

In a few words, the deployment is unchanged in terms of architecture and the configuration is adjusted for applying the "Zero-Trust" concept (please refer to LEXIS post on Zero Trust architecture [8]).

The configuration has been updated to reflect the complexity of the LEXIS platform, by adding a Keycloak *Client* for all components. The access management part is handled using attributes at Keycloak *Group* level, but this is not exposed anymore in the access token, but retrieved trough an API call to Keycloak in order to get the user information (then containing the authorization).

All Keycloak Clients have been restricted to only provide the information needed for the component assigned to the Client itself, thus helping to keep the token size as small as possible. Any component also needed to update their token management to be able to exchange the token received from another component to a token issued by their Keycloak Client in order to avoid using the same token in all component that would break the system when one component will refresh the token (by invalidating all other tokens as we are avoiding token spread).

3.6   LEXIS CYCLOPS INTEGRATION

Based on the additional requirements from Dynamic Allocator Module (see Deliverable D4.4 [9]), the credit monitor module functionalities were fine tuned. The Cyclops core services - UDR, CDR were slightly readjusted to allow periodic report generation every 15 minutes. The CDR micro-service APIs and Credit Manager APIs were integrated within Portal-API to enable unified access to Cyclops data points within LEXIS Portal.

The Cyclops Plan Manager module was configured to allow differentiated core hours normalization for different HPC clusters and further differentiation of cloud and non-cloud resources were enabled as part of the final roll-out of Cyclops integration with LEXIS platform stack services.

3.7   LEXIS PORTAL FRONTEND UPDATE (NEW SECTION)

Since Deliverable D8.2 [6], the most significant updates of LEXIS Portal front-end ensured that web-based user interface is in accordance with the main changes of services and interfaces which it relies on. These general main changes can be divided into several groups:

- React front-end conforms to more precise and restrictive AAI configuration,
- Users are allowed to create and deploy batches of workflow executions,
- Possibility to request approved resources from the project detail view,
- A lot of effort has been devoted to fix smaller bugs in various views of the Portal, providing users with seamless and easy experience when using the front-end,
- A professional template for the website was procured and deployed.

Aside from adapting the Portal to these (mainly) new changes of underlying APIs and services, shortly after previous deliverable we had been finalizing a complete rework and revamp of the Portal's biggest agenda - Data sets. The programming interface of data management was not undergoing any important updates (except fixing some bugs) and was at that time ready to use. The first version of the front-end views for controlling the dataset API were centred on exposing all the underlying functionality, with user-friendliness and usability being secondary concerns. Therefore, for the second version, a revamp of the data sets interface to increase user ease-of-use was given high priority in development.

Despite many difficult obstacles the revamp was successful, while keeping basically all features which the API is capable of. For example, creation (upload) of a new data set was divided into three steps, utilizing user-friendly and instructive wizard UI element, see Figure 1.
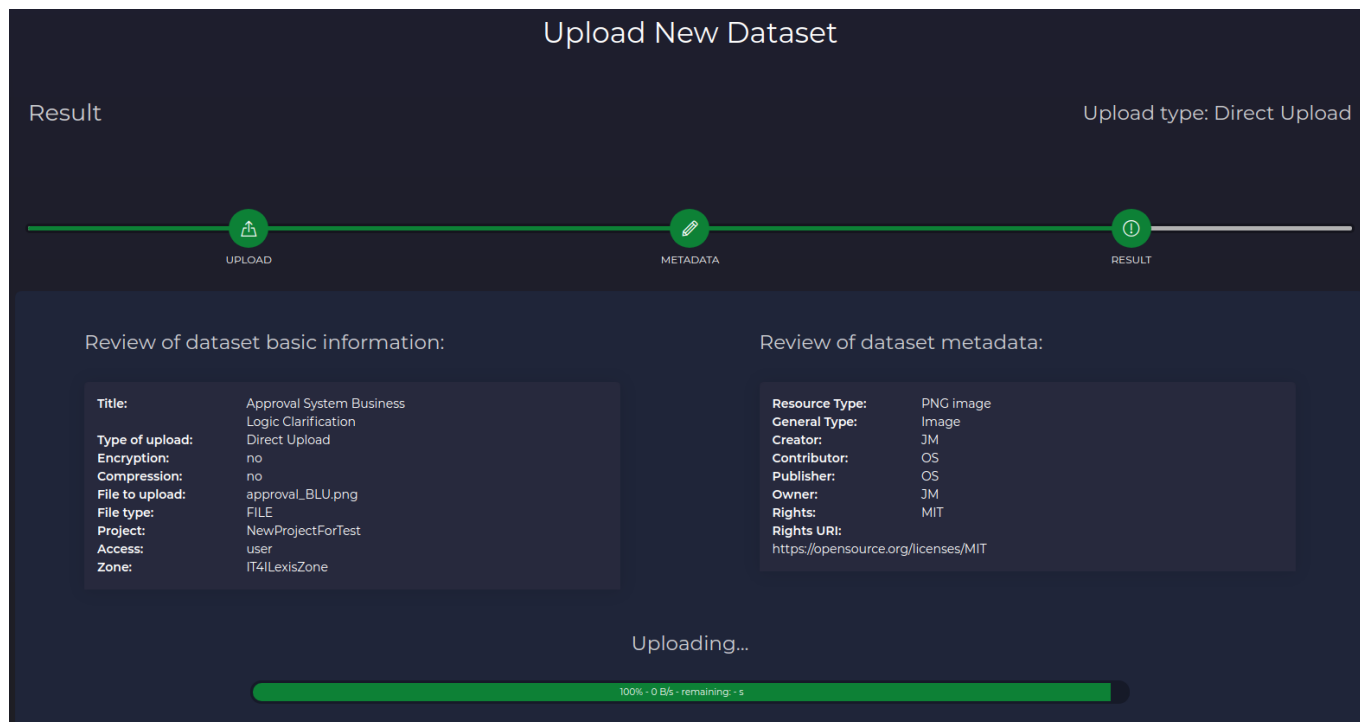
Figure 1 Screen of GUI for creation (upload) of a new data set divided into three steps

The table listing available data sets was provided with very fast keyword filtering by using a new feature of the latest version of React front-end library. A list of files within some data set allows user not only to perform expected basic tasks, i.e. to see and download files from inside of data set, but on top of that a user is able to open any image file or edit any plain text file (e.g. Python script) right from the UI. Also utilizing features of DDI's "staging API", like requesting a size of data set, replication, duplication and so on, can be seamlessly handled from the Data set UI.

Another big issue lied in adapting the Portal to Keycloak AAI system and its configuration, while the AAI specification was fine-tuned in last 3 months and it was undergoing major changes. For example, a new role "workflow manager" was added, and the front-end had to take it into account. Since our role-based access control model is not only "flat" but for several entities of LEXIS Portal also "multidimensional", few new issues had arisen by that fact which were needed to be properly addressed. What we mean by that? To put it exemplarily, some user can have "project manager" role for some projects while for another projects only "user" role. Since Portal's front-end originally counted with only flat model of user roles (one user = one set of permissions for everything), we had to extend inner workings of permissions and user roles of the front-end. It was done by saving all user's permissions for certain sets of entities to the Redux state of the front-end, and then by developing fine-tuned component wrappers which check permission of the given specific user for all components where the check like that is needed. In the end, we performed checking of all user roles in all possible scenarios on all LEXIS software being deployed online on testing virtual machines.

As of batch workflow executions, the main part of work is not readily visible but it was done "under the hood". A view was added in the Portal's UI, showing user a batch executions list instead of general executions. Users can find her/his executions planned in batch with all its details there.

Button "Add approved resources", with its view with possibility of requesting already approved resources, was added back in the Portal's UI. The main issue lied in getting up and running communication between LEXIS portal API <-> Approval system interface API <-> and HEAppE Approval System itself. Without this communication it would

not make sense to have the button in Portal's UI in place. The task to make the communication work was carried out successfully and user is able to request approved resources in HEAppE Approval System now. (The HEAppE Approval System itself is also currently ready to accept that kind of requests, it has been only waiting for its production deployment which is going to happen very soon).

4 LEXIS PORTAL DEPLOYMENT UPDATE

In the latest LEXIS release, deployment of the WP8 services is provided by the CI/CD system directly linked with the source code repositories that we have been working on enabling in the previous iterations of the platform.

In this last phase of the project, we upgraded our already fully functional CI/CD pipeline from a single target style into a dual target one, aiming to have a dual deployment for the whole LEXIS Portal services stack: one as production ready, the other focused on enabling the developers to keep on improving, fixing, and adding new functionality without disturbing the normal usage of the stable platform.

As mentioned in Deliverable D8.2 [6], the deployment infrastructure of the platform also counts with its share of the Configuration-as-Code paradigm, which was upgraded as well into the multi-target level, enabling the whole platform to keep our development and production configurations under a single source of truth under its own source controlled repository.

We also tested a cross-site connection of the LEXIS Portal hosted at IT4I to the back-end services hosted at LRZ, confirming that the Portal remains functional in this scenario. This helps reduce down-time in case a back-end is being maintained.

5 SUMMARY AND NEXT STEPS

Release R4 provides a revamped permission system from the LEXIS AAI, in which roles are used to adapt the portal appearance to the users´ permissions, an overhaul of the dataset management section to increase ease-of-use, resource allocation, and the possibility to create and execute batches of workflows. Updates to the back-end include changes to align with the API updates of other LEXIS components and tighter integration with cyclops.

The documentation has also been enhanced: updated video walk-throughs[7], LEXIS public documentation[8], and LEXIS GitHub project repository[9].

Due to the nature of the LEXIS project, we expect the portal to adapt in the future to possible changes in the rest of the LEXIS components, in order to expose new functionality to LEXIS users. Adaptation to address the comments provided by Open Call participants also remains a priority. Finally, updates regarding ease-of-use and security will ensure LEXIS a relevant platform for final users.

It is worth mentioning that a security audit will be conducted on a recurring basis and that any security issue will be handled in the development workflow. Updating the underlying components and libraries will be ensured by the LEXIS Platform maintenance team.

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[7] LEXIS YouTube channel: https://www.youtube.com/channel/UCiU3w-dw9-eaOCD4Zlf8qVw
[8] LEXIS project public documentation: https://docs.lexis.tech/
[9] 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, *D9.4 Open Call Framework and Stakeholders Engagement on Targeted Large-Scale Pilots - first report.*

[6] LEXIS Deliverable, *D8.2 Second Release of LEXIS Portal.*

[7] LEXIS Deliverable, *D9.10 Impact KPI and Metrics Achievements Report and Plan - final version.*

[8] "LEXIS Blog, Zero trust Architecture within LEXIS," 21 September 2021. [Online]. Available: https://lexis-project.eu/web/news/zero-trust-architecture-zta-within-lexis/.

[9] LEXIS Deliverable, *D4.4 Definition of workload management policies in federated cloud/HPC environments.*