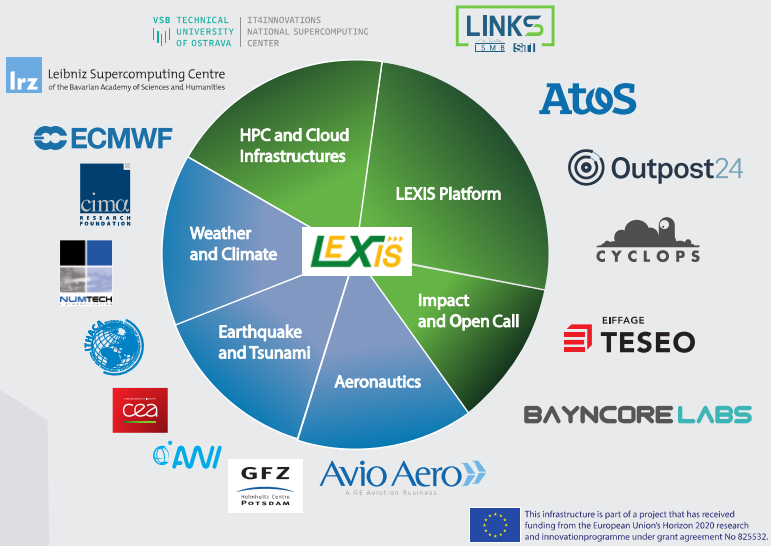
LEXIS PROJECT
LARGE-SCALE EXECUTION FOR INDUSTRY & SOCIETY

LEXIS NEWSLETTER

November 2020



LEXIS brings HPC and Cloud technologies closer to SMEs, industry and society

The new LEXIS platform can help industry, society and especially small and medium-sized enterprises (SMEs) to easily access and use efficient heterogeneous distributed infrastructures without the need for advanced computing knowledge. To lower the entry barriers to the worlds of supercomputing, cloud, and big data, an EU-funded project is testing its platform in aeronautics, earthquake & tsunami, and weather & climate domains.

The increasing quantity of data poses an enormous challenge for organisations seeking to extract knowledge critical for business, operations and research. Combinations of high-performance computing (HPC), Cloud, and Big Data technologies are key to meet the needs of large and small organisations alike.

However, this has been difficult up to now since most of the largest supercomputing centres have often served merely academic research e.g. in Physics.

> ***"The LEXIS (Large-scale EXecution for Industry & Society) project is building an advanced engineering platform at the confluence of HPC, Cloud, and Big Data, which uses large-scale geographically-distributed resources from the existing HPC infrastructure, employs Big Data analytics solutions and augments them with Cloud services,"*** explains the project coordinator Dr. Jan Martinovič from IT4Innovations.

The platform is driven by the requirements of three initial pilot use cases, and further ones being selected via an Open Call planned in the second half of the LEXIS project.

The **aeronautics** pilot mainly focuses on accelerating turbomachinery and rotating-parts simulation workflows by direct code acceleration. In addition, advanced hydrodynamics simulation capabilities are now used to predict fluid flow around complex geometries under turbulent motion in the Rotating Parts use-case.

Earthquake and tsunami simulations and warnings are in the focus of the second pilot. The main achievement was a clear formalisation of the complex workflows, which run under time-constrained conditions. The computational efficiency of the tsunami simulation code was improved, therefore delivering results of a potential tsunami wave inundation in less than a minute enabling faster and more accurate emergency warnings.

Last but not least, the **weather and climate** large-scale pilot deals with advanced workflows to predict e.g. flash floods, agricultural yields, forest fires and air quality, all based on numerical weather forecasts. The models have been packed into ready-to-run containers and virtual machines, and efficient procedures for handling the data and data quality assurance from different sources have been set up. Prototypes of the workflows are implemented and tested on the LEXIS infrastructure which paves the way for the subsequent assimilation of multiple observational weather data in order to make all our predictions even more reliable.

Based on the LEXIS pilots, several needs shared by SMEs and industry were identified within a number of different fields:

- dynamic data-aware orchestration of complex workflows,
- data sharing between Cloud and HPC resources and distributed data management with appropriate data backend to the orchestration solutions,
- access to HPC/Big Data/Cloud resources for SMEs and industry including novel compute and data acceleration through e.g. GPUs, FPGAs and Burst Buffers, and
- easy control of workflows and data through a user-friendly web interface with single sign on to the platform via a federated AAI and seamless integration of remote visualisation services.

To deliver the best user experience, typical user scenarios were collected together with the pilot partners giving invaluable feedback. Based on these, a LEXIS Portal as a one-stop-shop for usage of the platform is being designed. At present, there are prototype views for managing users in the projects, for accessing and listing available datasets, for deployment and running of applications, and for monitoring and billing.

“

“LEXIS has opted for the security-by-design approach where security is one of the pillars of the architecture as crucial as compute and data management. A federated, fault-tolerant and modern authentication and authorization framework has been implemented. It provides LEXIS users single-sign-on and role-based authorizations across the entire data and service providers community,” points out Marc Levrier from Atos company. ***“In addition to regular cloud and HPC resources, diverse acceleration technologies (GPU, FPGA, Burst Buffers) can be referred to from the application workflows exposed in the LEXIS portal and allocated by the orchestrator at execution time,”*** adds Marc Levrier.

The solutions provided by LEXIS will enable improved cooperation between industry and academia. The new platform will ensure that SMEs and industries are able to use the appropriate resources for their applications in a user-friendly manner.

“

“To improve the quality of the LEXIS platform, an Open Call is planned, in which partners from academia and business will be asked to test their applications on the LEXIS platform and provide feedback. This should also increase the impact of the project and establish a presence in various communities of potential users,” adds Dr. Martinovič.

LEXIS PROJECT
LARGE-SCALE EXECUTION FOR INDUSTRY & SOCIETY

LEXIS

Open Call 2020–2021

The European future of computing is tomorrow, try it today!

The LEXIS platform will be delivered at market usage standards in December 2021. From end of 2020 until November 2021, companies and researchers can use and test the platform within the framework of the LEXIS Open Call. The LEXIS consortium is making millions of core hours (CPU/GPU/FPGA) and more than 600 person-days of support available to applications selected among those submitted in the Open Call.

The participation is free of charge. The exact date of the opening of the Open Call is planned in December 2020 and will be soon communicated, on the LEXIS website and by official news releases.

Why participate?

Applicants can take this opportunity to participate in the LEXIS Open Call for:

- testing their application experiments in a real converged HPC/Cloud/Big Data environment,
- scaling their application before entering full scale operational level,
- demonstrating the results or potential results,
- refining their software architectures in development phase, and
- using an architecture mixing CPUs/GPUs and in some cases FPGAs.

Who can participate?

We are open to projects from various external stakeholders representing different key industrial sectors and domains:

- research organizations
- industry & services
- large companies
- SMEs
- start-ups
- EU-funded projects (H2020 / EuroHPC) which match programmatically and administratively

Industrial sectors or application domains

- Aeronautics
- Earthquake, Tsunami & Flooding
- Weather & Climate
- Automotive
- Civil Protection
- Engineering
- Healthcare
- Life Sciences & Pharmaceuticals
- Manufacturing
- Oil & Gas
- Weather-related information services

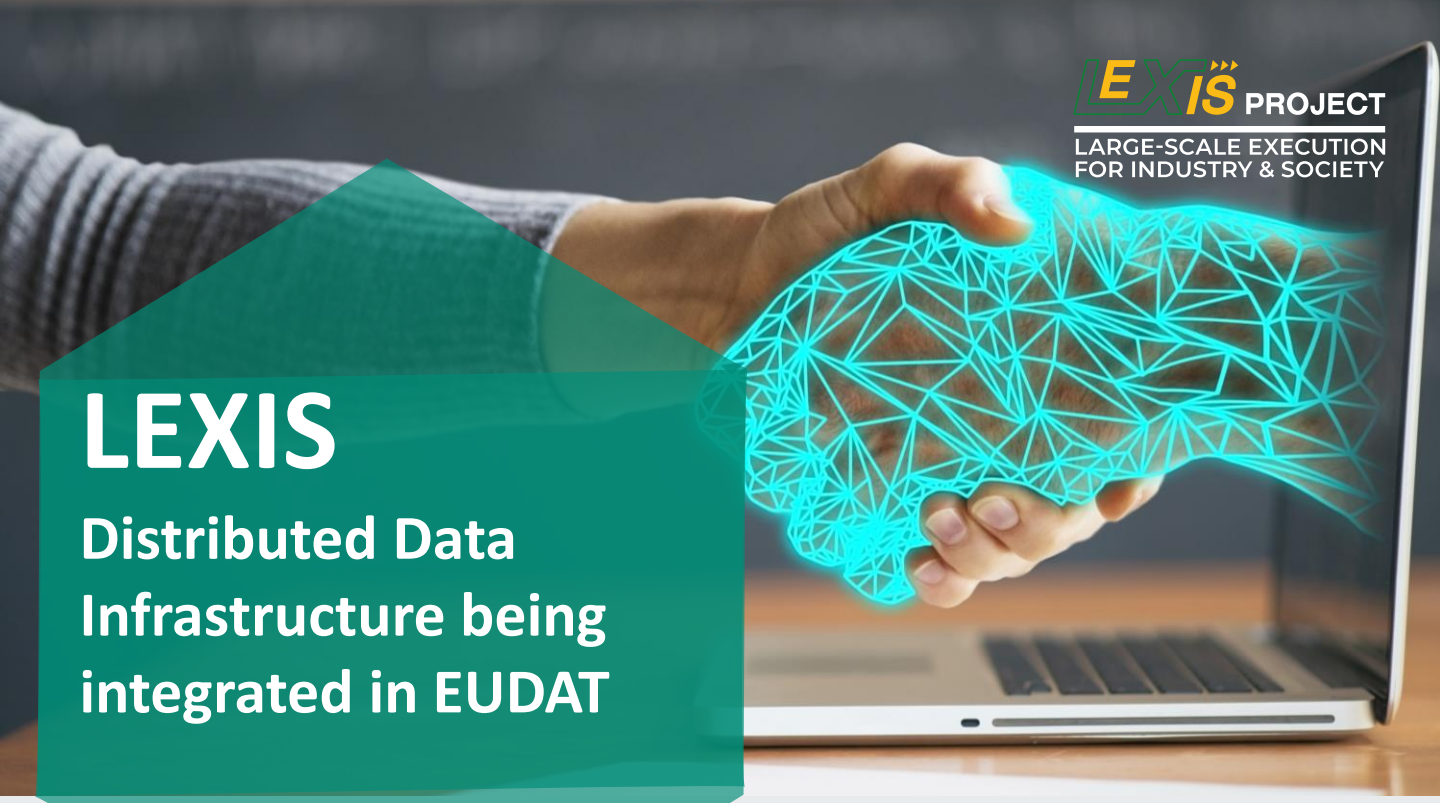
How to participate?

The LEXIS website will very soon provide all necessary information and the access to the web forms to be used for registering your candidature to the Open Call. Registering your participation will be as simple as 1, 2, 3!

More information:

Open Call web page:
lexis-project.eu/web/open-call/
LEXIS project: lexis-project.eu

We invite everybody not registered for this newsletter yet to do so and stay informed about the Open Call: lexis-project.eu/web/subscribe.



LEXIS PROJECT
LARGE-SCALE EXECUTION FOR INDUSTRY & SOCIETY

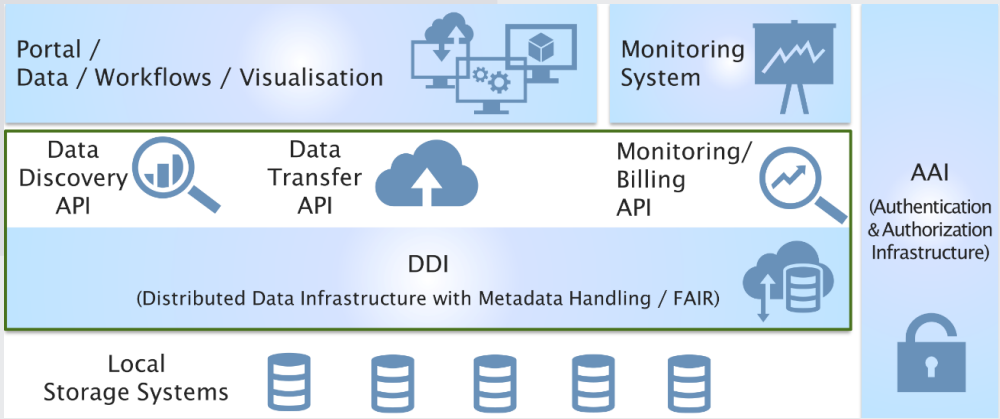
LEXIS

Distributed Data Infrastructure being integrated in EUDAT

The LEXIS Data System allows users to consistently manage input, output and temporary data of their workflows. Its core component is the Distributed Data Infrastructure (DDI), which unites the storage systems of the LEXIS infrastructure layer and can be conveniently accessed via REST APIs.

The DDI is based on the "Integrated Rule-Oriented Data System" (iRODS) and B2SAFE of the "European Data Collaborative Data Infrastructure" (EUDAT CDI).

The integration of LEXIS with EUDAT is one step towards a unified, European research data management infrastructure following the FAIR principles (Wilkinson et al., 2016, doi.org/10.1038/sdata.2016.18).
It gives us direct possibilities to connect our data system with other European data centres and projects.



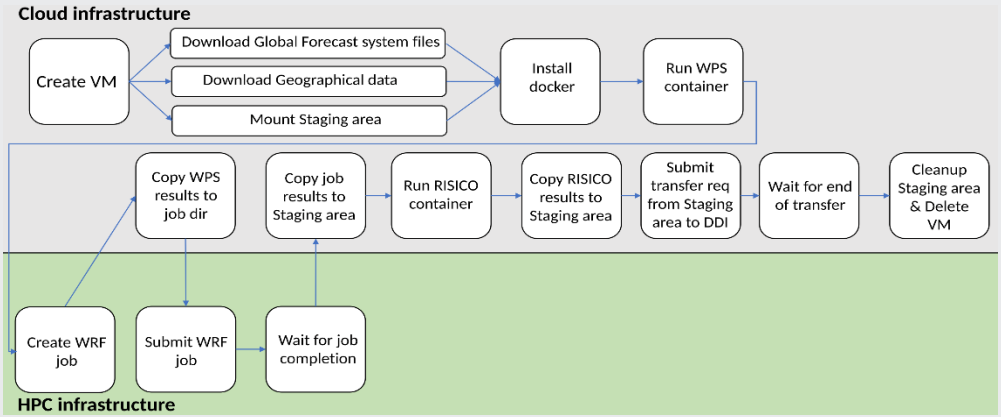
The DDI and its APIs within the LEXIS infrastructure (LEXIS-WP3 public slide)

LEXIS users can interact with their data through the LEXIS Portal. iRODS automatically manages cross-site data transfer wherever necessary. The novel Burst Buffer systems in LEXIS can be used to prefetch and cache remote data, if data transfer takes too long.

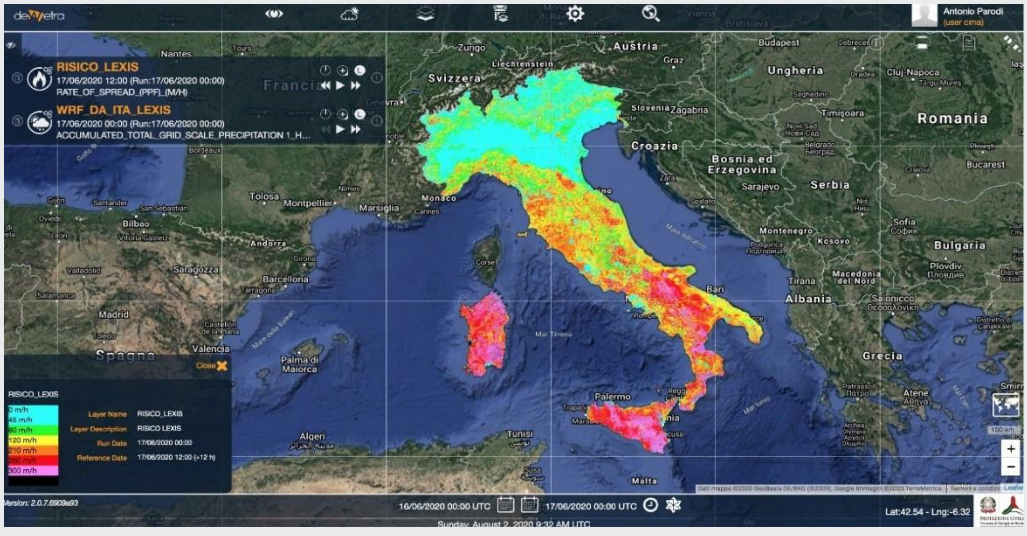
Recently, we published the first results with the “Weather and Climate Large Scale Pilot” workflows that exploit the LEXIS Computing and Distributed Data Infrastructure (Parodi et al., 2020, doi.org/10.1007/978-3-030-50454-0_25). We are proud to announce them at CISIS 2020 and at SC 2020 with a poster.

Currently, we are working to benchmark the DDI system, while considering different network bandwidths between LEXIS sites.

The LEXIS Orchestration System will be aware of physical data locations and typical transfer speeds. Thus, it can select suitable storage and computing sites to execute a given workflow with the best performance and user experience.



Forest fire prediction and prevention workflow as executed by the orchestrator (CIMA, ATOS, LRZ)



Workflow results visualised with Dewetra platform (Italian Department of Civil Protection, CIMA)

LEXIS

Activities in brief

NOVEMBER 2020

EGI Conference 2020

November 2 – 4, 2020, online

- **Mohamad Hayek (LEXIS – LRZ)** gave a talk on **"Federated Research Data Management in LEXIS"** for more than 60 participants. Questions and discussions showed the audience's interest in LEXIS technology.

- **Marc Levrier (LEXIS – Atos) and Alberto Scionti (LEXIS – LINKS Foundation)** presented one of the core themes of LEXIS: workflow orchestration in heterogeneous, federated HPC/Cloud environments in the Workflow Management Solutions session at the EGI. Their talk had the title **"Workflow Orchestration on tightly federated Computing Resources: the LEXIS Approach".**

SC20

November 9 – 19, 2020, online

- Along with the VESTEC project, PNNL and NCAR, **Thierry Goubier (LEXIS – CEA)** organised the **"HPC for Urgent Decision Making"** workshop at the SC20. This workshop started with a keynote by Professor Marathe from UVA, where he described the challenges of undertaking real-time epidemiologic modelling and forecasting for the Covid-19 Pandemic, followed by four technical presentations and a roundtable of worldwide efforts in various projects on urgent computing. Workshop web page www.urgenthpc.com

- The poster presented at SC20 **"Orchestration of a Forecasting Chain for Forest Fire Prevention Using the LEXIS Cloud/HPC Platform"** demonstrates a workflow on forest fire risk assessment. It's the first successful application of the LEXIS platform for advanced orchestration of complex simulation and data-analysis workflows in mixed cloud/HPC environments.
  Poster bit.ly/SC20_LEXIS_Poster

DECEMBER 2020

36th INTERNATIONAL CAE CONFERENCE 2020

November 30 – December 4, 2020, online

- **Donato Magarielli (LEXIS – Avio Aero)** will give talks in two breakout sessions "Aerospace & Defense"; collateral event "High Performance Computing, a key enabler for digital transformation". His presentation **"CFD-based aeronautical Turbomachinery Case Study in the EU-funded LEXIS Project"** will illustrate how the newly added GPU acceleration within the TRAF code can drastically reduce execution time for analyses of low-pressure turbines. Link www.caeconference.com/aerospace.html

HPC/Big Data/Cloud Webinar with MESAP Innovation Cluster

December 10, 2020, 11am CET

- In collaboration with MESAP (MEccatronica e Sistemi Avanzati di Produzione, Innovation Cluster for Smart Products and Smart Manufacturing – @mesapcluster), **LEXIS** brings its technologies to future users in a webinar. This will focus on **HPC, Big Data and Cloud, and how these technologies can be easily and efficiently accessed by industry and SMEs.**

JANUARY 2021

101st AMS (American Meteorological Society) Annual Meeting

January 10 – 15, 2021

- **ECMWF** will present a **LEXIS contribution on cloud-based data analysis workflows**, enabling cloud access to the world's largest meteorological archive and real-time global forecasts. The AMS annual meeting is the world's largest yearly gathering for the weather, water, and climate community. Link annual.ametsoc.org/index.cfm/2021/