LEXIS

Large-scale EXecution for Industry & Society

Orchestration of a Forecasting Chain for Forest Fire Prevention using the LEXIS Cloud/HPC Platform

M. Hayek[1], L. Ganne[2], Antonio Parodi[3], Andrea Parodi[3], M. D'Andrea[3], R. García-Hernández[1], M. Golasowski[4], S. Hachinger[1], E. Danovaro[5], J. Munke [1], F. Donnat[6], A. Scionti[7], G. Vitali[7], K. Slaninová[4], O. Terzo[7], J. Martinovič[4]

(1) Leibniz Supercomputing Centre, Garching b. M. (D); (2) ATOS, Paris (F); (3) CIMA Research Foundation, Savona (IT); (4) IT4Innovations, VŠB – Technical University of Ostrava, Ostrava (CZ); (5) ECMWF, Reading (UK); (6) Outpost24, Antibes (F); (7) Advanced Computing and, Applications, LINKS Foundation, Torino (IT)

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36 months

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€12.2 M / €14 M

LEXIS DISTRIBUTED DATA INFRASTRUCTURE AND ORCHESTRATION

OBJECTIVES

- Provide researchers and industry with a user friendly platform to execute optimized simulation workflows on Cloud/HPC systems.
- Federate internationally competitive supercomputing and data centers (currently IT4I/CZ, LRZ/DE, ECMWF/UK), taking advantage of advanced orchestration and data management techniques.
- Efficient data management in an European HPC/Cloud Context: FAIR[1] Research Data (Findable, Accessible, Interoperable, Reusable).

ORCHESTRATION

- The LEXIS HPC/Cloud Orchestration System provides an application deployment platform for Hybrid HPC/Cloud applications.
- Applications to be deployed are modeled using TOSCA[2] (Topology and Orchestration Specification for Cloud Applications).
- The orchestrator back-end is based on the Yorc solution[3] and the front-end is based on Alien4Cloud[4] developed by Atos.
- A plugin extending the orchestrator to support the management of HPC resources through the middleware HEAppE[5], developed by IT4I is used.

COORDINATOR
JAN MARTINOVIC (IT4I)
jan.martinovic@vsb.cz

CO-DESIGN MANAGER
Olivier Terzo (LINKS)
olivier.terzo@linksfoundation.com

DISTRIBUTED DATA INFRASTRUCTURE

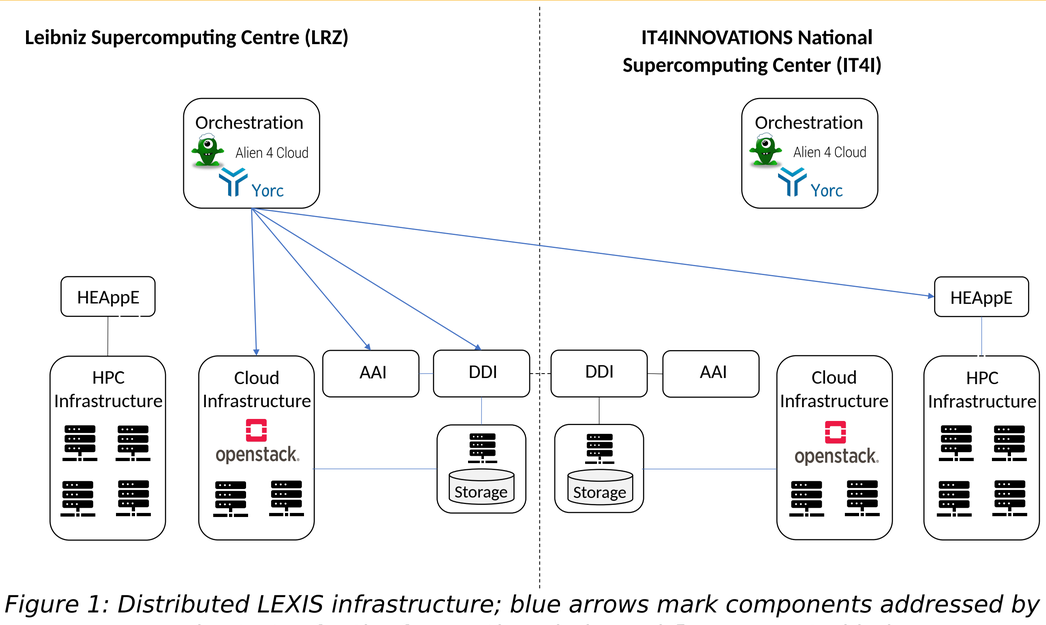


Figure 1: Distributed LEXIS infrastructure; blue arrows mark components addressed by the orchestrator for the forecasting-chain workflow presented below.

- As part of the LEXIS platform, a federated iRODS[6] (Integrated Rule-Oriented Data System) was deployed. It provides unified access to files on different backend systems distributed at LRZ and IT4I.
- On top of iRODS, EUDAT[7] B2HANDLE and B2SAFE were deployed for Persistent Identifier (PID) management and data replication. EUDAT B2STAGE is used for data transfer to HPC and GridFTP systems.
- Django/Swagger-based RESTful APIs were developed for data staging between LEXIS storage systems, and for metadata assignment and listing, in order to adhere to the FAIR princples.
- The DDI is connected to the LEXIS Authentication and Authorization Infrastructure (AAI) via OpenID Connect and provides appropriate access management.

ORCHESTRATION OF A FORECASTING CHAIN FOR FOREST FIRE PREVENTION

ORCHESTRATED WORKFLOW

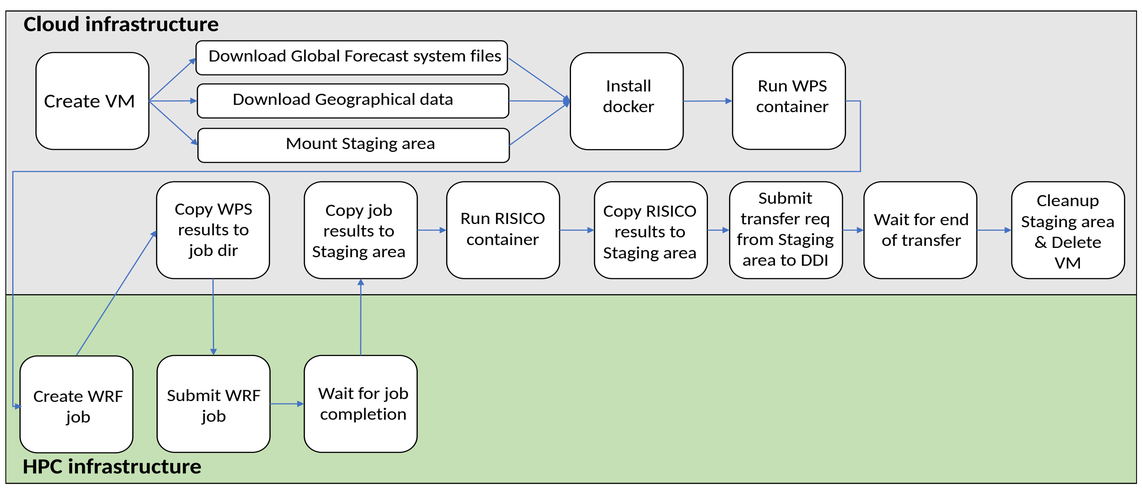


Figure 2: Orchestrated forest fire prevention workflow.

- First workflow running on the LEXIS platform: forecasting chain driving the RISICO model for forest fire risk assessment based on the compute intensive Weather Research & Forecasting[8] (WRF) model
- The Workflow (Figure 2) starts with a creation of a virtual machine on the OpenStack-based LRZ Compute Cloud. Input data are downloaded and a WRF Pre-Processing System (WPS) container is executed.
- A WRF job is then executed on IT4I's Salomon HPC system. After completion, data are staged back to LRZ, where the RISICO system is run for predicting/assessing forest-fire risk.
- The Staging API is used to move the workflow results to iRODS, and further to CIMA for visualization via EUDAT B2STAGE.

WORKFLOW RESULTS - FUTURE WORK

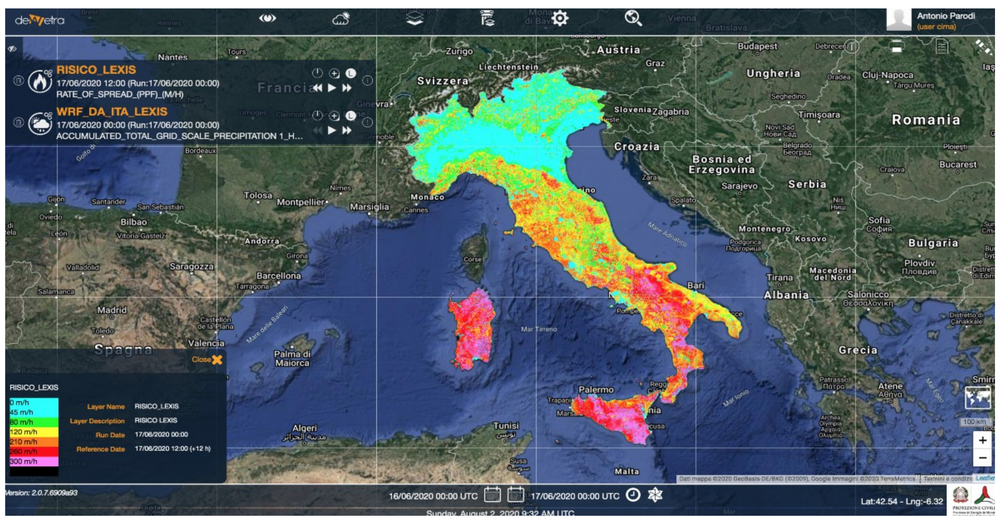


Figure 3: Workflow results visualized with the Dewetra platform.

- The results are visualized with the Open-source based Dewetra platform[9] of the Italian Department of Civil Protection, developed by CIMA Foundation for environmental monitoring and civil protection.
- Figure 3 shows example results over Italy on the 17th of June, 2020. On that day, high fire intensity is seen in Sardinia, Calabria, northern Italy, and Basilicata. The rate of spread was expected to be high in Southern Italy, parts of Sicily, and in Sardinia.
- Future work in LEXIS focuses on generalizing, benchmarking and optimizing the platform in a co-design approach with users. An Open Call is attracting further use cases from, e.g., healthcare and life sciences.

REFERENCES

[1] Wilkinson M.D. et al., 2016, Scientific Data, 3, 160018 **[2]** Topology and Orchestration Spec. for Cloud Applications, 2013, docs.oasis-open.org/tosca/TOSCA **[3]** yorc.readthedocs.io/ **[4]** alien4cloud.github.io **[5]** heappe.eu **[6]** irods.org **[7]** eudat.eu **[8]** Skamarock, W. C. et al., 2019, Technical Report NCAR/TN-556+STR, NCAR. **[9]** CIMA Research Foundation, in: Proceedings of ISCRAM-med 2014, Toulouse, France, Oct. 15-17, 2014, 165-177

Workflow results

CONTACTS

LEXIS Project Website: www.lexis-project.eu
Mohamad Hayek: mohamad.hayek@lrz.de
LEXIS WP3 lead: S. Hachinger - stephan.hachinger@lrz.de
LEXIS WP7 lead: A. Parodi - antonio.parodi@cimafoundation.org
Laurent Ganne: laurent.ganne@atos.net