

# The Evolution of INFN's Cloud Platform: improvements in Orchestration and User Experience

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Over the past years, the Italian National Institute for Nuclear Physics (INFN) has developed and refined its cloud platform, designed to facilitate access to distributed computing and storage resources for scientific research. This evolution in Platform-as-a-Service (PaaS) orchestration has focused on enabling seamless service deployment, improving user experience, and integrating innovative solutions to address changing demands and technological challenges.

INFN's journey toward a robust cloud platform began with the deployment of a national cloud system designed to streamline access to distributed resources. A key element of this initiative was a user-friendly web portal, the INFN Cloud Dashboard, allowing users to instantiate high-level services on-demand. This was achieved through TOSCA templates processed by an orchestration system that supported a lightweight federation of cloud sites and automated scheduling for optimal resource allocation.

The orchestration system used by INFN Cloud is based on the open-source INDIGO PaaS middleware, designed to federate heterogeneous computing environments. It plays a crucial role in orchestrating virtual infrastructure deployment, enabling high-level services like Jupyter Hub, Kubernetes, and Spark clusters. The core component, the Orchestrator, is supported by micro-services, facilitating the optimal selection of cloud providers based on specific deployment requirements.

In the context of the internal INFN DataCloud project and some European projects like interTwin and AI4EOSC, INFN is undertaking a comprehensive revamp of its PaaS system to accommodate the changing technology landscape and replace old and legacy software components. A key example of this effort is the transition from the legacy Configuration Management Database (CMDB) to the Federation-Registry, a modern solution built on the FastAPI framework and using neo4j, a flexible graph database. This transition will ensure more robust and scalable management of federation-related information, supporting a diverse set of cloud providers and modern security protocols.

To further optimize the orchestration system, INFN is exploring the use of artificial intelligence to improve deployment scheduling. The Cloud Provider Ranker, which provides the list of providers based on various metrics and Service Level Agreements (SLAs), is going to be enhanced with AI techniques. This improvement will allow for the identification of meaningful metrics, creation of predictive models for deployment success/failure, and regression models for deployment times. These models will enable a more dynamic and accurate ranking of cloud providers, leading to more efficient resource usage and a reduction in deployment failures.

Finally, the PaaS dashboard, which serves as a gateway for user interaction with the orchestration and service deployment system, recently underwent a major renovation to improve usability and security. The dashboard redesign aimed to offer a more secure, efficient, and user-friendly interface while providing a visually appealing design.

This contribution will outline the key advancements in the PaaS orchestration system aimed at supporting scientific communities with a reliable, scalable, and user-friendly environment for their computational needs.

## Topic

Needs and solutions in scientific computing: Platforms and gateway

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