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Federation Manager: a New Component for the Federated Resource Management in INFN Cloud

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As part of the strategic refactoring and modernization of the INFN Cloud orchestration system, the Federation Manager has been developed to enhance the flexibility, scalability, and interoperability of the distributed DataCloud infrastructure. This initiative represents a key step in the long-term evolution of INFN Cloud toward a more modular, service-oriented architecture capable of supporting hybrid and multi-cloud orchestration across heterogeneous resource providers. Within this context, the Federation Manager plays a central role by automating the federation of new providers and managing resource access requests from scientific communities in a unified and secure procedure.

The service architecture is built on a Python backend, leveraging the FastAPI framework to implement RESTful APIs that follow best practices and relevant RFC standards. This ensures high performance, consistency, and ease of integration with other components of the INFN Cloud.

A modern, responsive web interface, developed with React and Next.js, provides users with a clear and intuitive experience for managing provider federations and resource allocations. Designed using Figma, the interface focuses on scalability and maintainability, aligning with the shared design principles adopted across the PaaS ecosystem.

Authentication and authorization mechanisms are based on OAuth2 and OpenID Connect (OIDC), ensuring secure, standards-compliant identity management. Centralized and flexible policy enforcement is achieved through Open Policy Agent (OPA), while Apache Kafka handles asynchronous communication with other PaaS components, guaranteeing reliability and scalability in data exchange.

A dedicated Python-based monitoring component complements the Federation Manager by periodically executing Rally benchmarking tests on the federated cloud providers. This module automates the evaluation of performance indicators such as compute, storage, and network efficiency, collecting metrics that are stored and analyzed to detect anomalies or degradation in service quality. The integration of this testing component provides continuous insight into the health and reliability of the federated infrastructure, supporting proactive maintenance and capacity planning.

By defining reusable API specifications, adopting shared UI frameworks, and integrating modern security and policy technologies, the Federation Manager contributes to a coherent and sustainable technical framework for INFN Cloud. This unified approach simplifies the integration of new services, improves maintainability, and strengthens the overall interoperability of the platform. Ultimately, the Federation Manager supports INFN Cloud's mission to provide a robust, extensible, and standards-aligned infrastructure for data-intensive scientific research in federated and multi-cloud environments.

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