

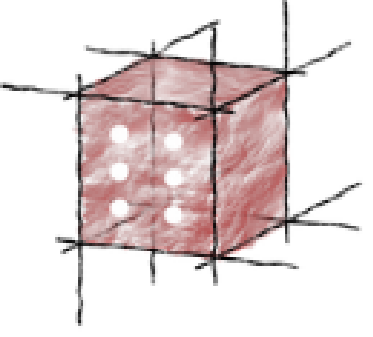
# Model Execution Environment for Investigation of Heart Valve Diseases

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Investigations leading to practical implementations of personalized medicine are challenging. The main goal of the EurValve project is to combine a set of complex modeling tools to deliver a workflow which will enable evaluation of medical prospects and outlook for individual patients presented with cardiovascular symptoms suggesting valvular heart disease. This research should result in a decision support system (DSS) which can be applied in clinical practice. This research activity requires a dedicated problem solving environment which we refer to as the Model Execution Environment (MEE).

## 1. Objectives

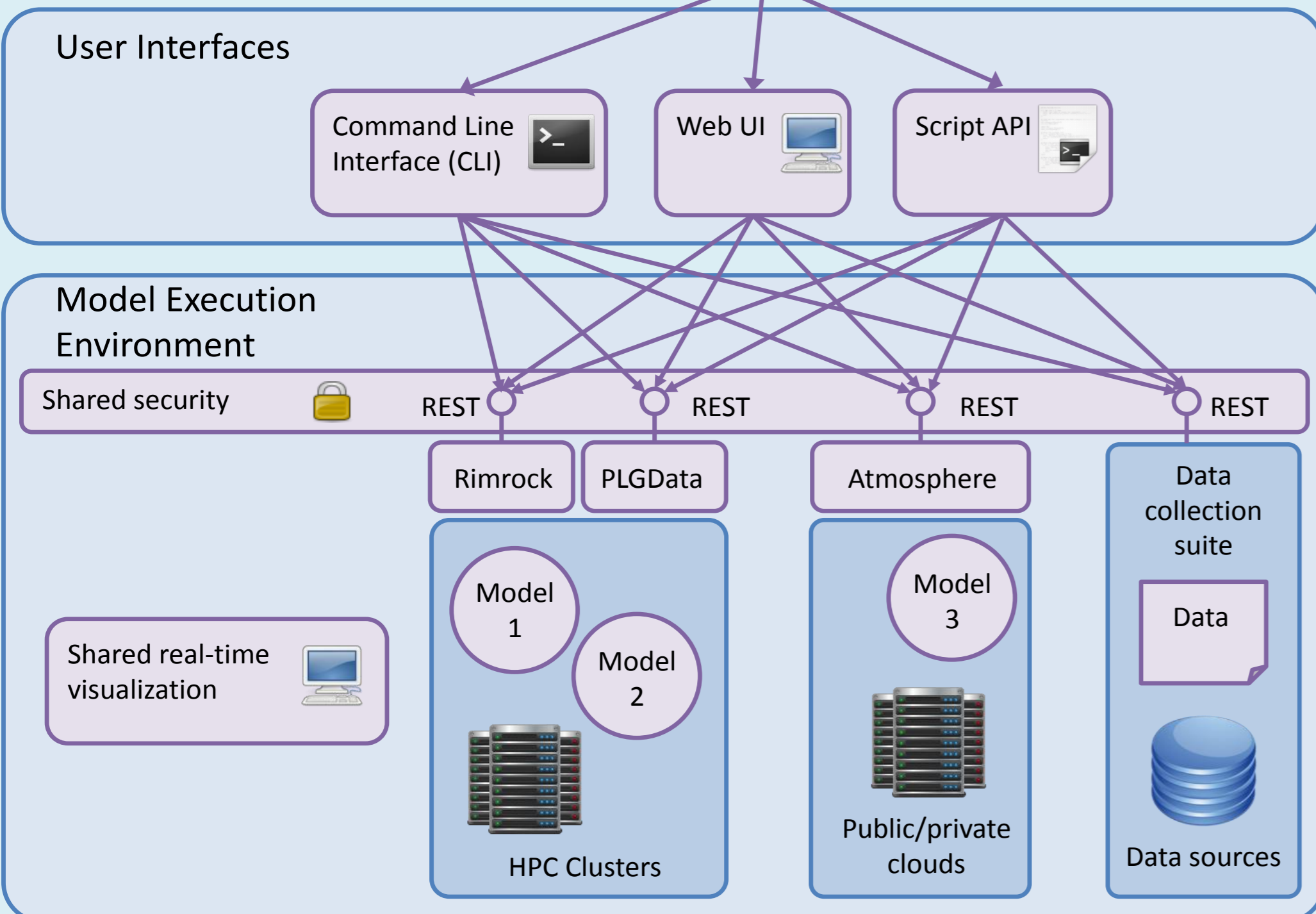
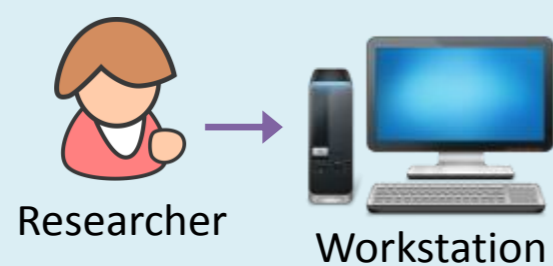
To develop and provide the necessary infrastructure to

- Collect, represent, annotate and publish data
- Store and grant secure access to all necessary data
- Execute the models in the most appropriate computational infrastructure
- Support real-time multiscale visualization
- Process encrypted data in public clouds

To deploy and operate the infrastructure, ensuring

- Quality of deployed software components
- Quality of service, including such aspects as availability, responsiveness and cost efficiency

## 3. Architecture of MEE



- Various access methods (GUI, CLI, scripting) via secure REST APIs
- Built on top of the robust Atmosphere platform
- Uses a selection of middleware services to submit computation
- HPC, private and public cloud resources with advanced visualization

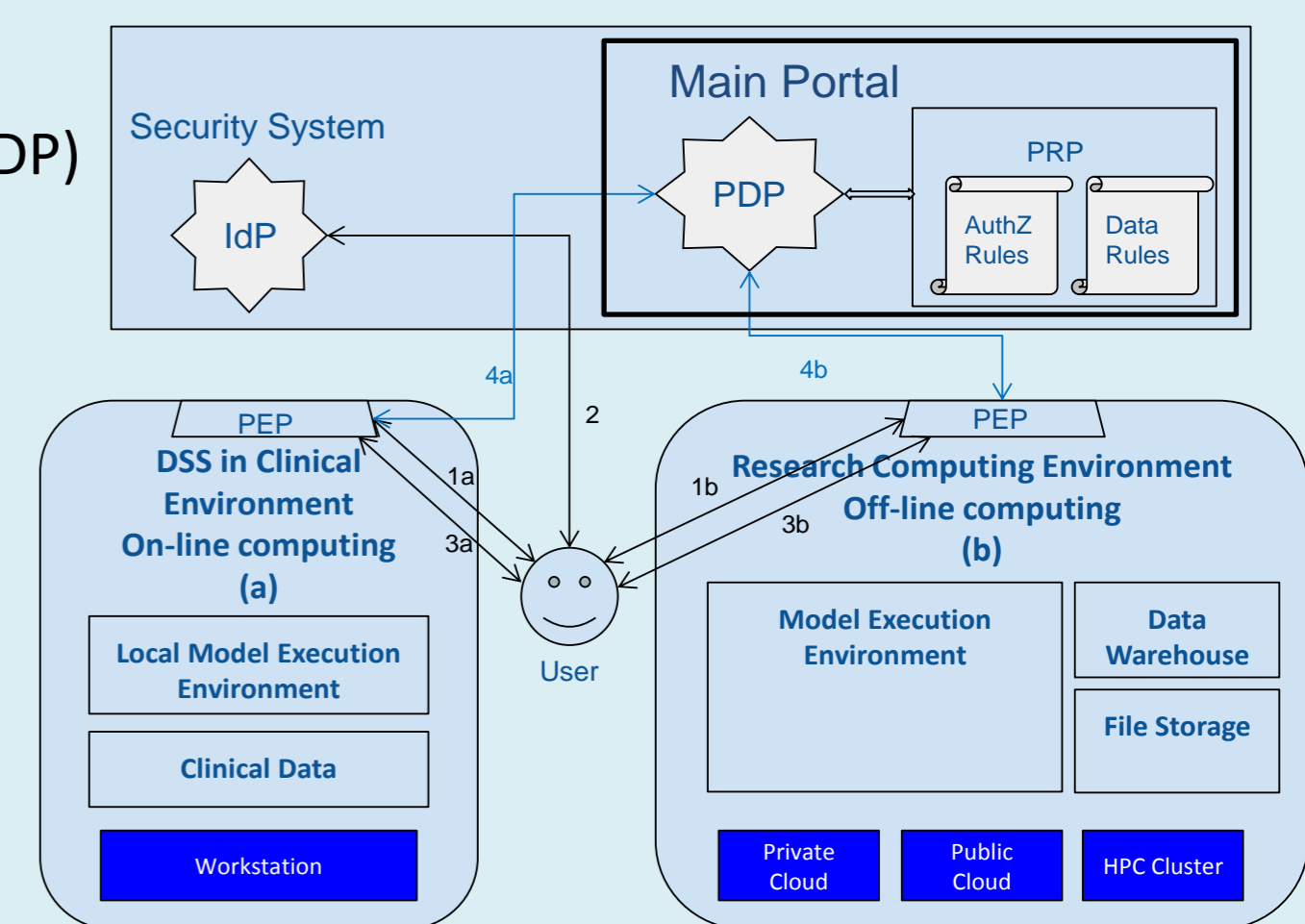
Atmosphere

## 2. Simulation Pipeline

The envisioned data flow consists of steps involving image segmentation, proteomics analysis and literature mining to construct system models which, in turn, enable building reduced order models as the knowledge base for the DSS.

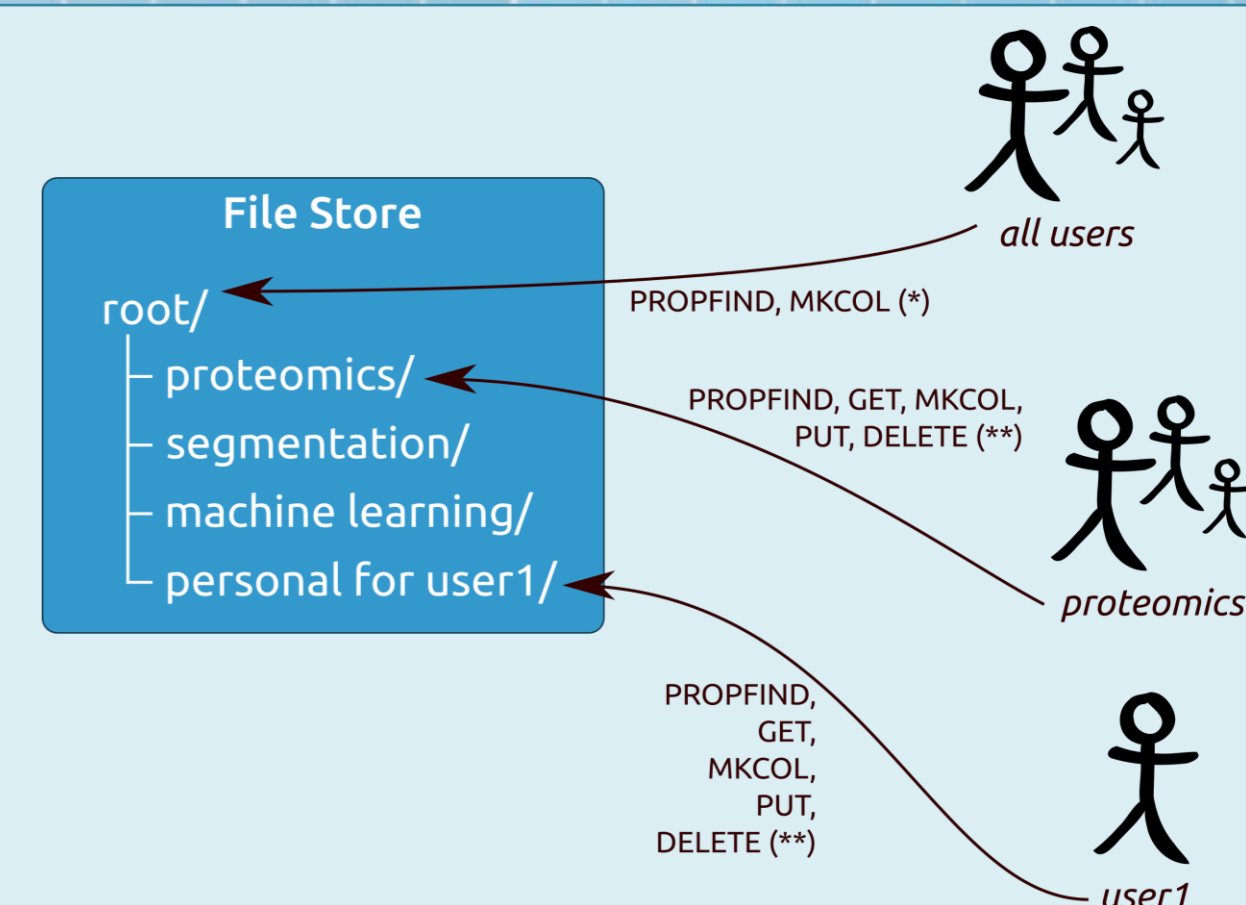
## 4. Security

- Policy Decision Point (PDP) available as a service
- GUI for configuring resource permissions
- JWT tokens used
- Policy Enforcement Point implemented as an Nginx module
- Fine-grained data security (policies based on access methods)



## 5. File Store

- WebDAV standard compliant
- Accepts JWT token delegation
- Access fully customizable by data owners
- Provides a web-based file browser



## 6. Summary

- Detailed requirements formulated and state-of-the-art in the area of valvular diseases analyzed
- Detailed design recommendations relating to model-based research environments established
- Prototypes of the Model Execution Environment, with supporting File Store and Integrated Security components facilitating simulations with the aim to develop decision support systems for heart diseases

## References

- M. Kasztelnik, E. Coto, M. Bubak, M. Malawski, P. Nowakowski, J. Arenas, A. Saglimbeni, D. Testi, and A. F. Frangi, Support for Taverna Workflows in the VPH-Share Cloud Platform, to be published in Computer Methods and Programs in Biomedicine
- Web resources: <http://www.eurvalve.eu> (Project website), <https://valve.cyfronet.pl> (EurValve Portal), <https://files.valve.cyfronet.pl> (EurValve File Store)



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