

A Virtual Imaging Platform for the Virtual Physiological Human



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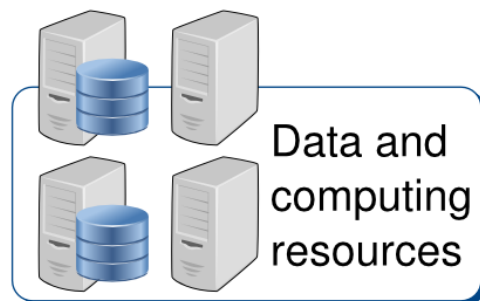
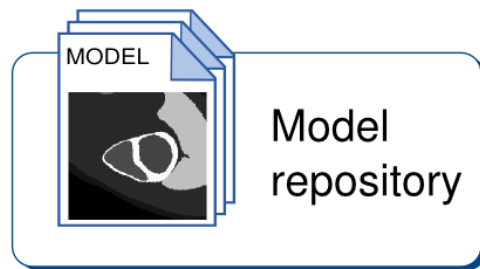
VPH 2012 Conference
September 18th-20th, 2012
London, UK

Overview

- The Virtual Imaging Platform – VIP
- Exemplar Project – VIP for VPH
- Interface with the VPH Toolkit
- VIP for VPH in action
- Concluding remarks

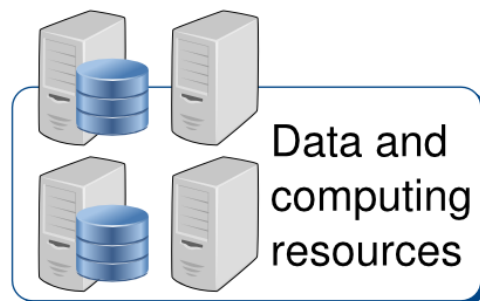
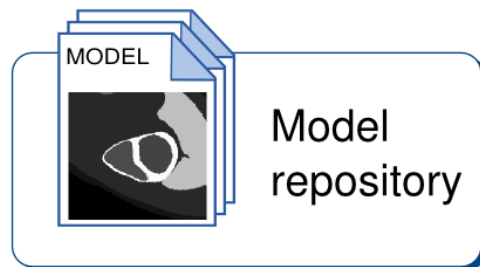


The Virtual Imaging Platform - VIP



- Multi-modality medical image simulators: MRI, US, CT, and PET.
- Simulators described as workflows.
- Geometric definition and physical parameters such as proton density, echogenicity, radioactivity, chemical composition.
- Ontologies (ongoing work by INRIA Rennes).
- European Grid Infrastructure (EGI).
- Biomed Virtual Organization.

The Virtual Imaging Platform - VIP

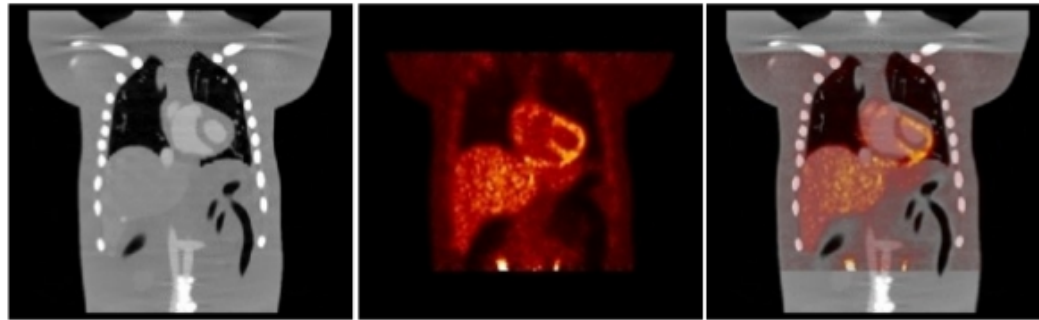


Motivation

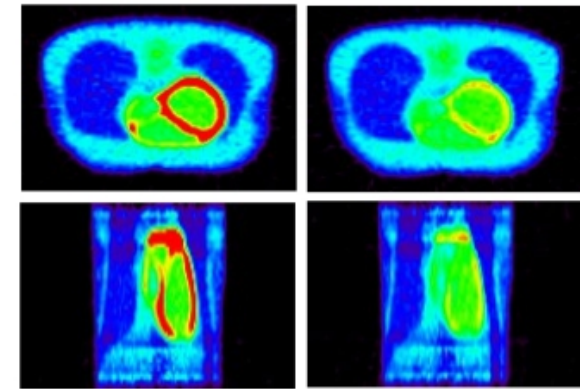
- **Imaging**
 - Test new image sequences
 - Prototype imaging devices
- **Image processing**
 - Evaluate algorithms (e.g. segmentation)
 - Design realistic human models
- **Educational**
 - Test sequence parameters
 - Investigate artifacts

The Virtual Imaging Platform - VIP

Goal: support heavy simulations.

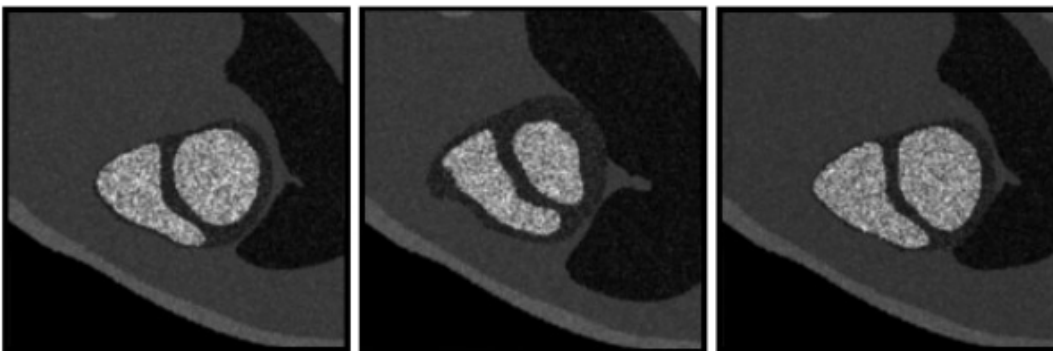


13 h



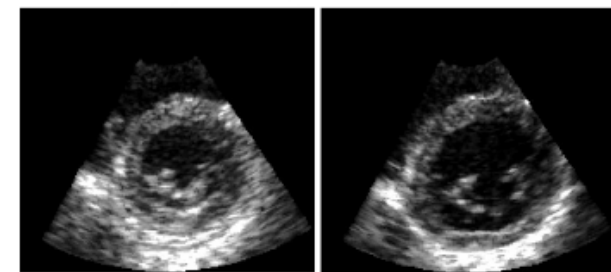
91 h

FDG-PET simulation of a healthy (left)
and pathological heart



7.5 h

Three instants of a 2D+t MRI cardiac simulation



42 h

End-systolic (left) and end-diastolic (right)
Instants of a simulated 2D+t echocardiography

The Virtual Imaging Platform - VIP

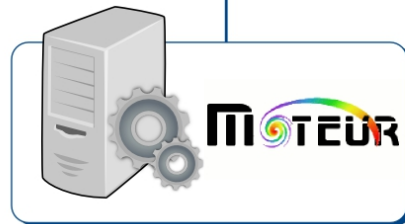
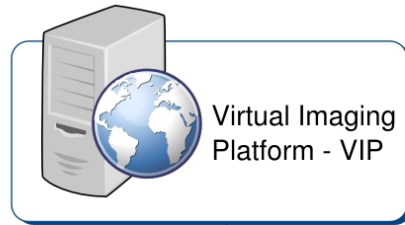
VIP Architecture

User Front-End

- Openly-accessible web portal.
- Access point to models and simulators.
- User-friendly interface which assist users in using image simulators.

Workflow Engine

- MOTEUR workflow engine.
<http://modalis.i3s.unice.fr/software/moteur/>



VIP - System Architecture

The Virtual Imaging Platform - VIP

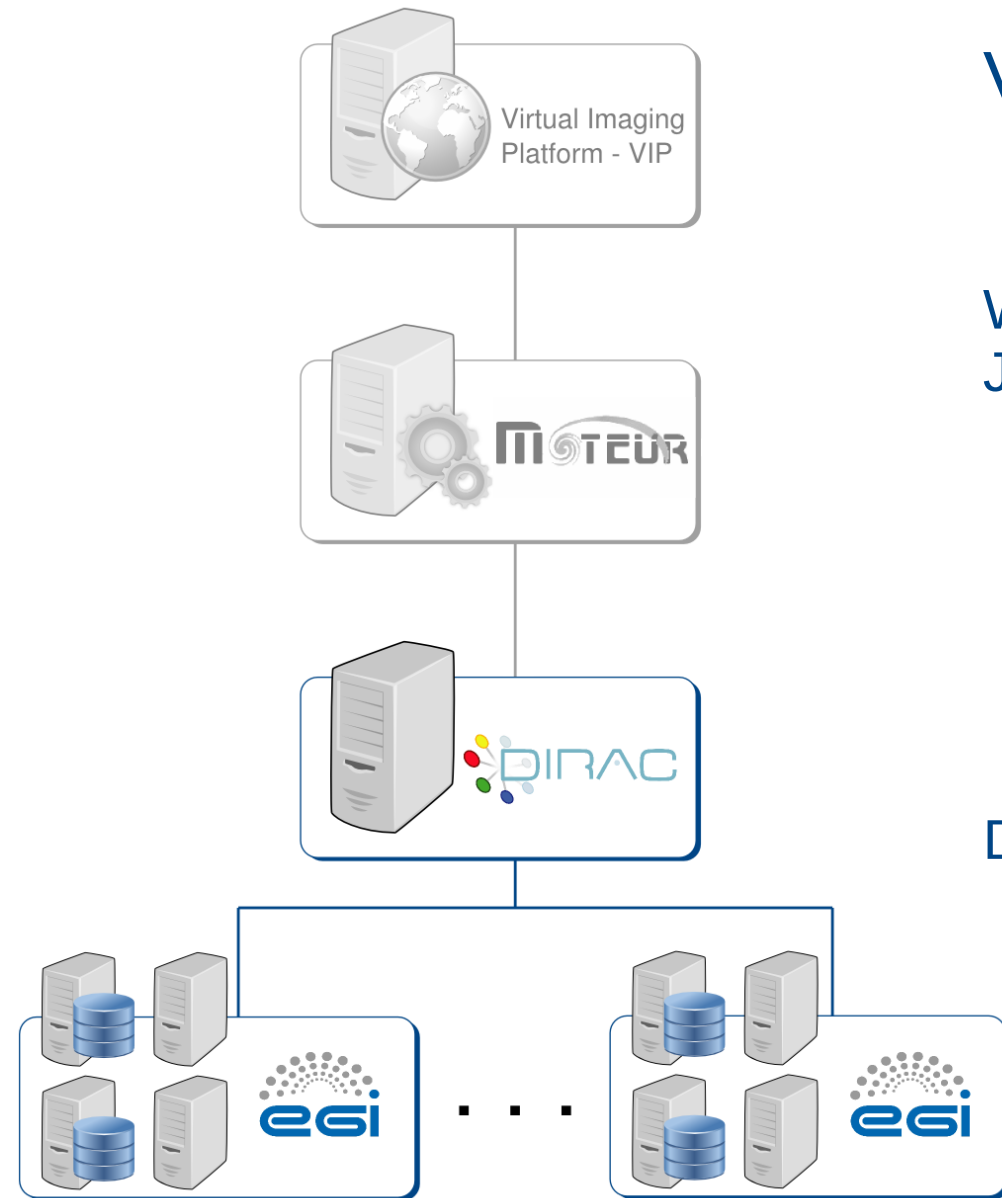
VIP Architecture

Workload Management System with Pilot Jobs

- Distributed Infrastructure with Remote Agent Control (DIRAC) [CPPM – LHCb].
<http://diracgrid.org/>

Data Storage and Computing Back-End

- EGI infrastructure.
<http://www.egi.eu/>

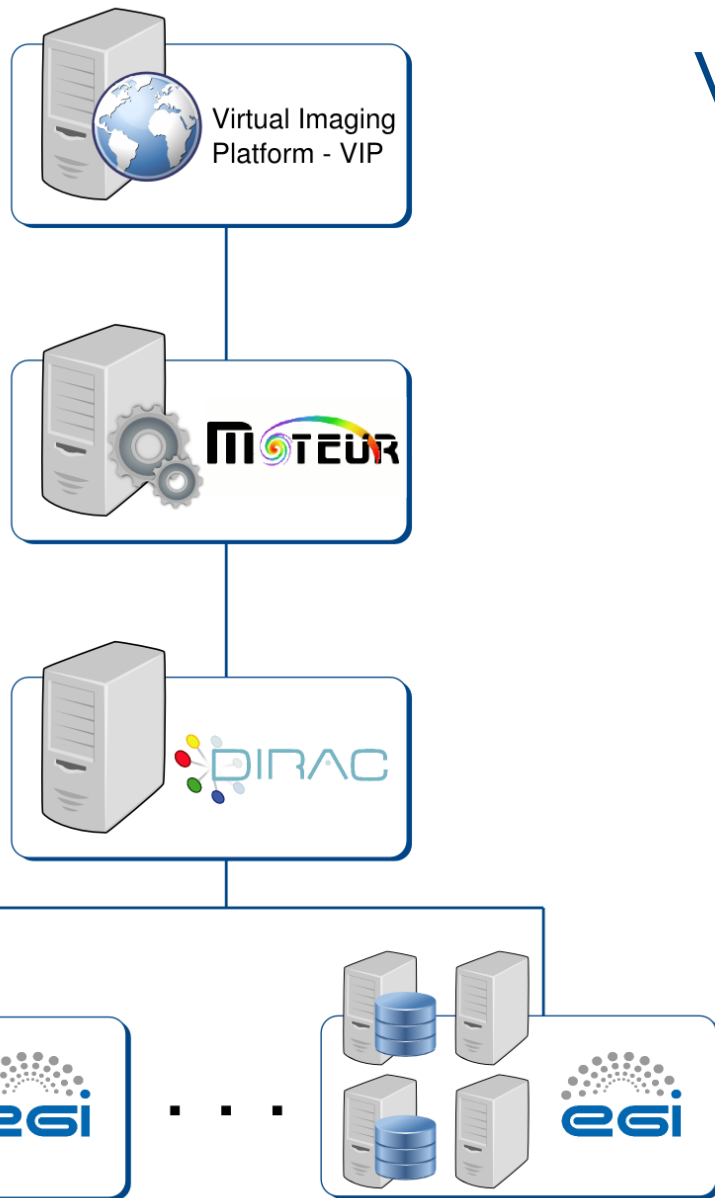


VIP - System Architecture

The Virtual Imaging Platform - VIP

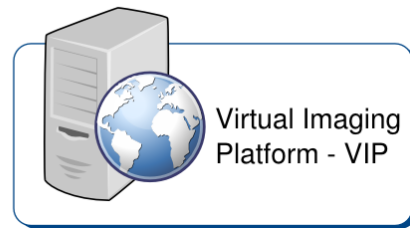
VIP Facts

- **250** registered users, from **25** countries.
- Most used portal certificate in EGI.
https://wiki.egi.eu/wiki/EGI_robot_certificate_users
- Consummed 379 CPU years from January 2011 to August 2012.
<http://accounting.egi.eu>
- 1/10 of the total activity of the biomed international VO. One of the most active users.

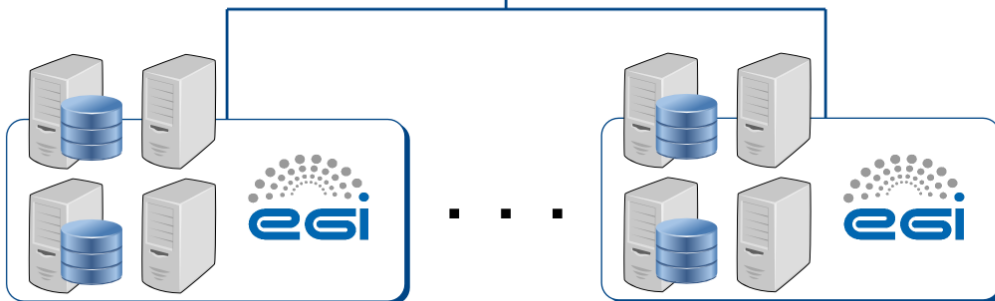
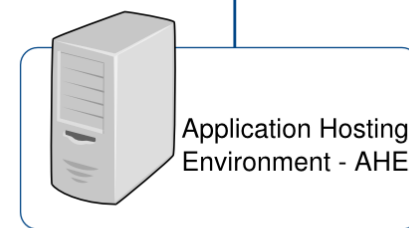
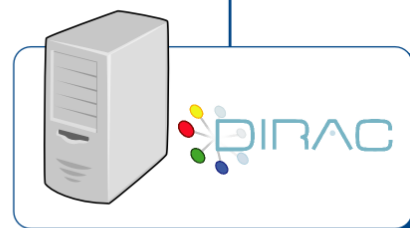
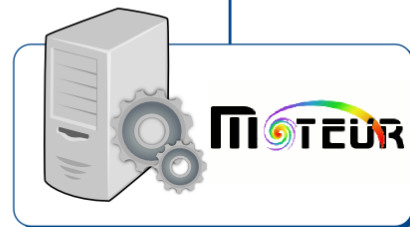


VIP - System Architecture

Exemplar Project – VIP for VPH

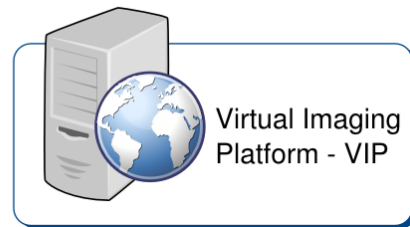


- MPI execution is not reliable on the current infrastructure.
- Execute VIP simulations on PRACE resources (dedicated, MPI).



VIP for VPH
System Architecture

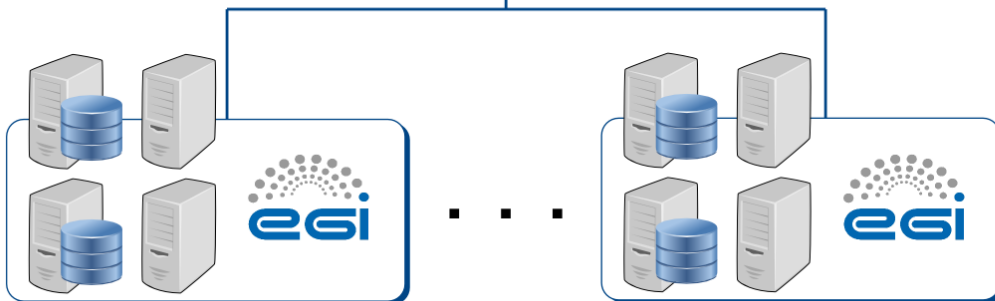
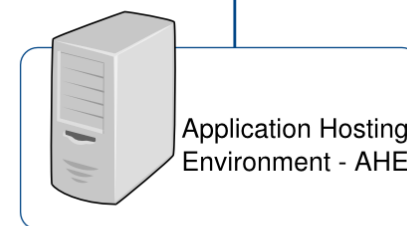
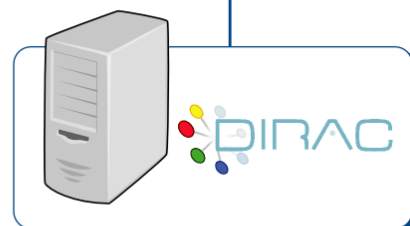
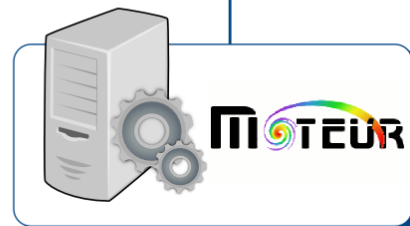
Exemplar Project – VIP for VPH



- A mechanism for the execution of medical image simulation workflows on HPC resources through workflow interoperability between the VIP and AHE.

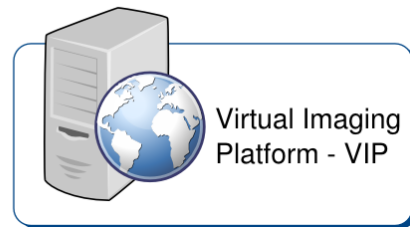
- Interface MOTEUR engine with the Application Hosting Environment.

<http://www.realitygrid.org/AHE/>



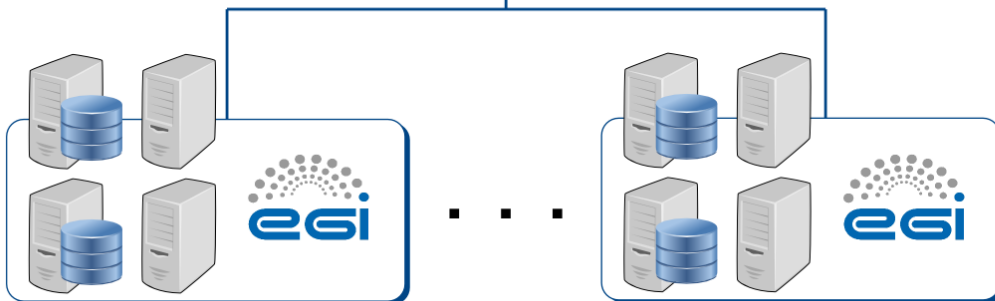
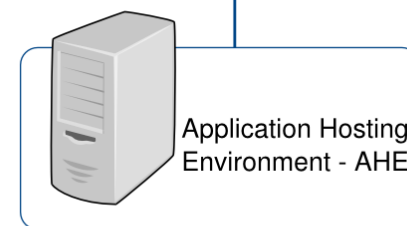
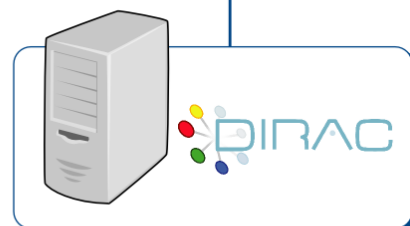
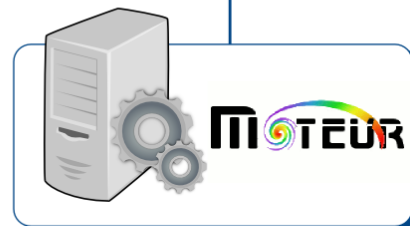
VIP for VPH
System Architecture

Exemplar Project – VIP for VPH



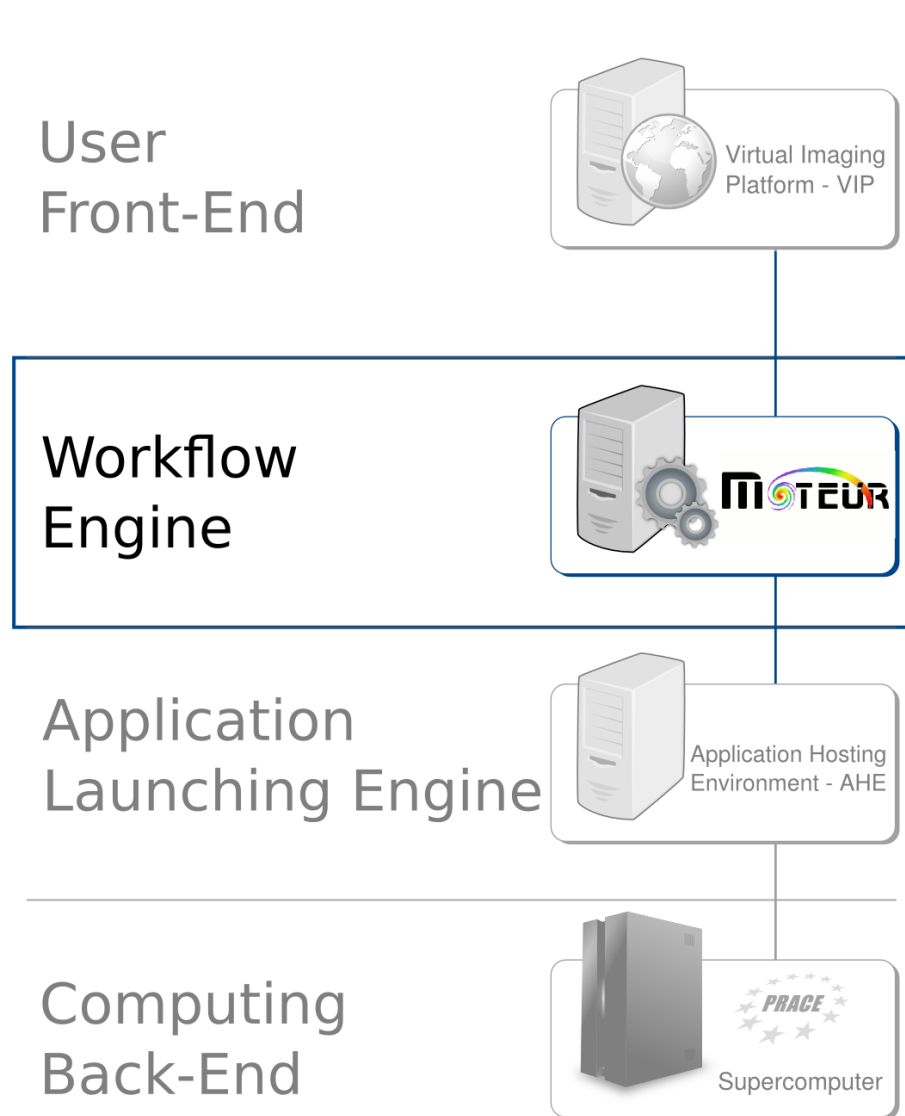
- This work was granted access to the HPC resources of The Edinburgh Parallel Computing Centre – EPCC made available within the Distributed European Computing Initiative by the PRACE-2IP.

<http://www.prace-project.eu>



VIP for VPH
System Architecture

Interface with the VPH Toolkit



MOTEUR

<http://modalis.i3s.unice.fr/software/moteur/>

- Generic Application Service Wrapper (GASW) enables to access several Distributed Computing Infrastructures.

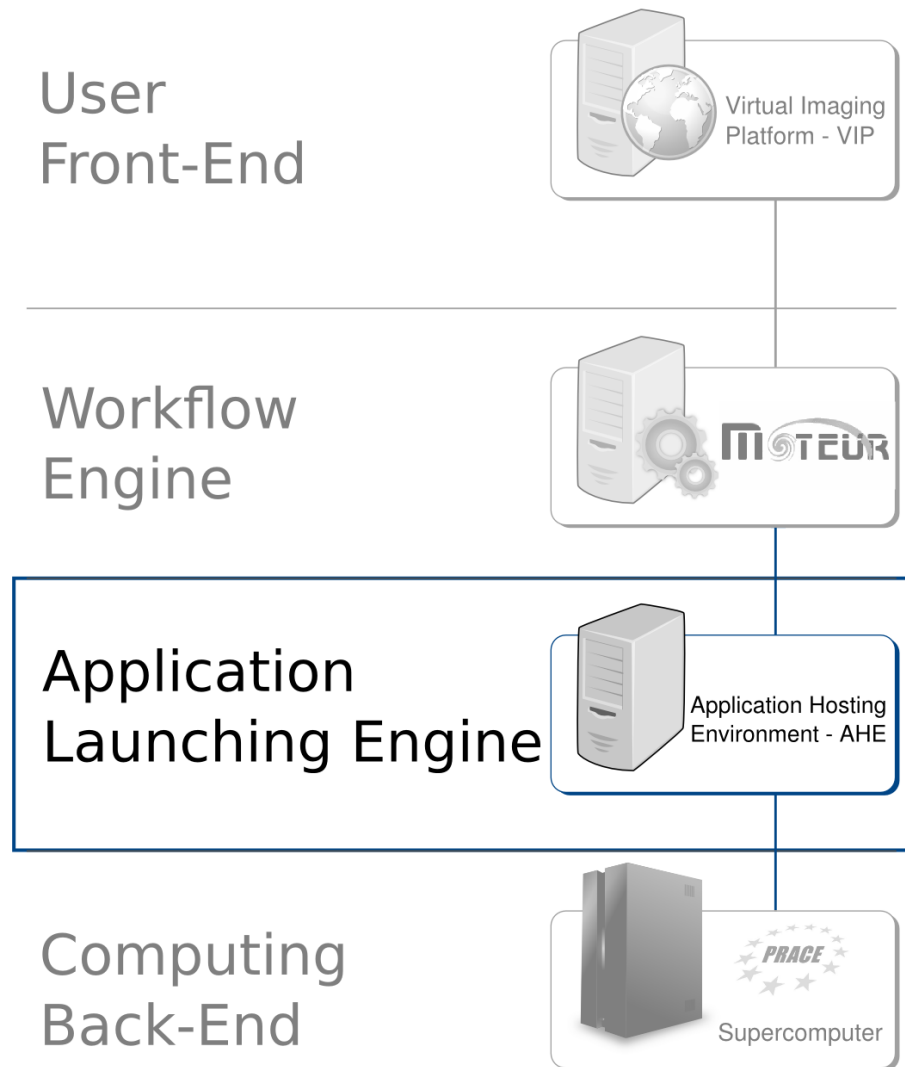
<http://vip.creatis.insa-lyon.fr:9002/projects/gasw>

- The GASW AHE plug-in enables GASW to access AHE resources.
 - Launch and monitor jobs.
 - Data transfer.

<http://vip.creatis.insa-lyon.fr:9002/projects/ahe>

VIP for VPH - System Architecture

Interface with the VPH Toolkit



VIP for VPH - System Architecture

The Application Hosting Environment

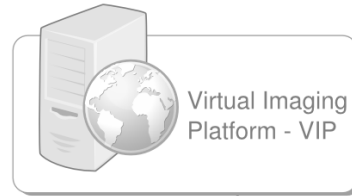
<http://www.realitygrid.org/AHE/>

- Part of the VPH ToolKit, freely available to the VPH community.
- Interfaces to back-end middlewares (i.e. Globus 2/4, Unicore 6)
- Manages submission and monitoring of jobs as well as data transfer.

Interface with the VPH Toolkit

VIP for VPH - System Architecture

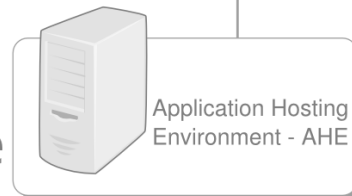
User
Front-End



Workflow
Engine



Application
Launching Engine



Computing
Back-End



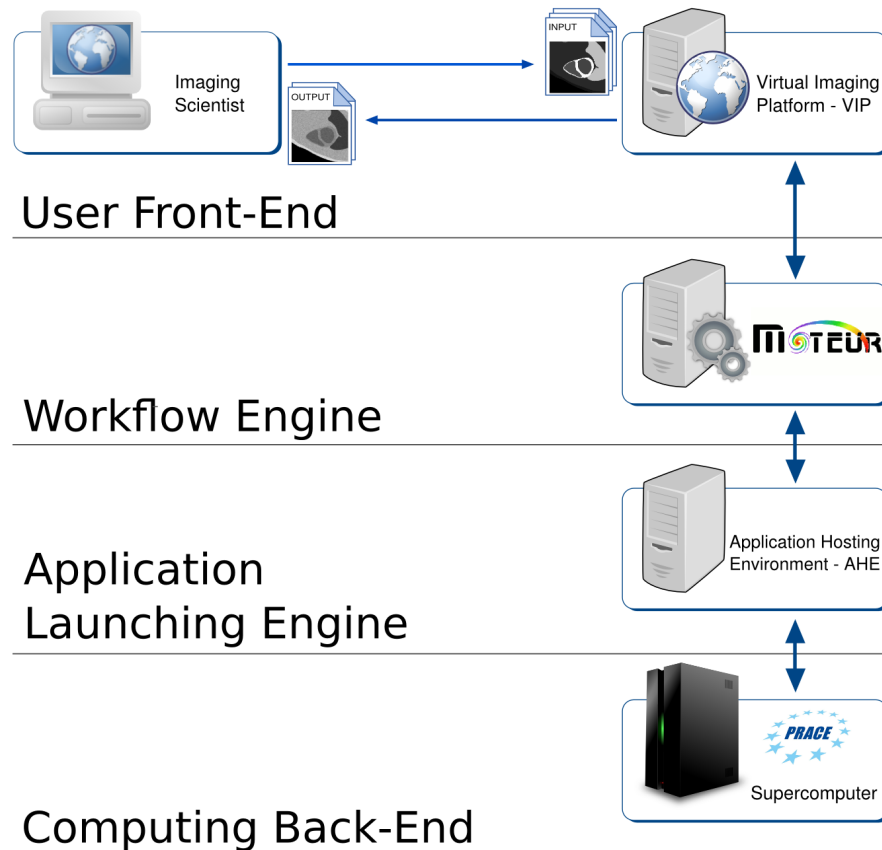
HECToR

<http://www.hector.ac.uk>

- High-End Computing Terascale Resource
- Located at The Edinburgh Parallel Computing Centre – EPCC, UK.
- Cray XE6 system:
 - 90,112 cores (AMD Opteron 2.3GHz Interlagos processors)
 - 90 Tb memory (Each 16-core processor shares 16Gb of memory)



VIP for VPH in action



VIP for VPH - System Architecture

Use Case Scenario

- A heavy MRI simulation

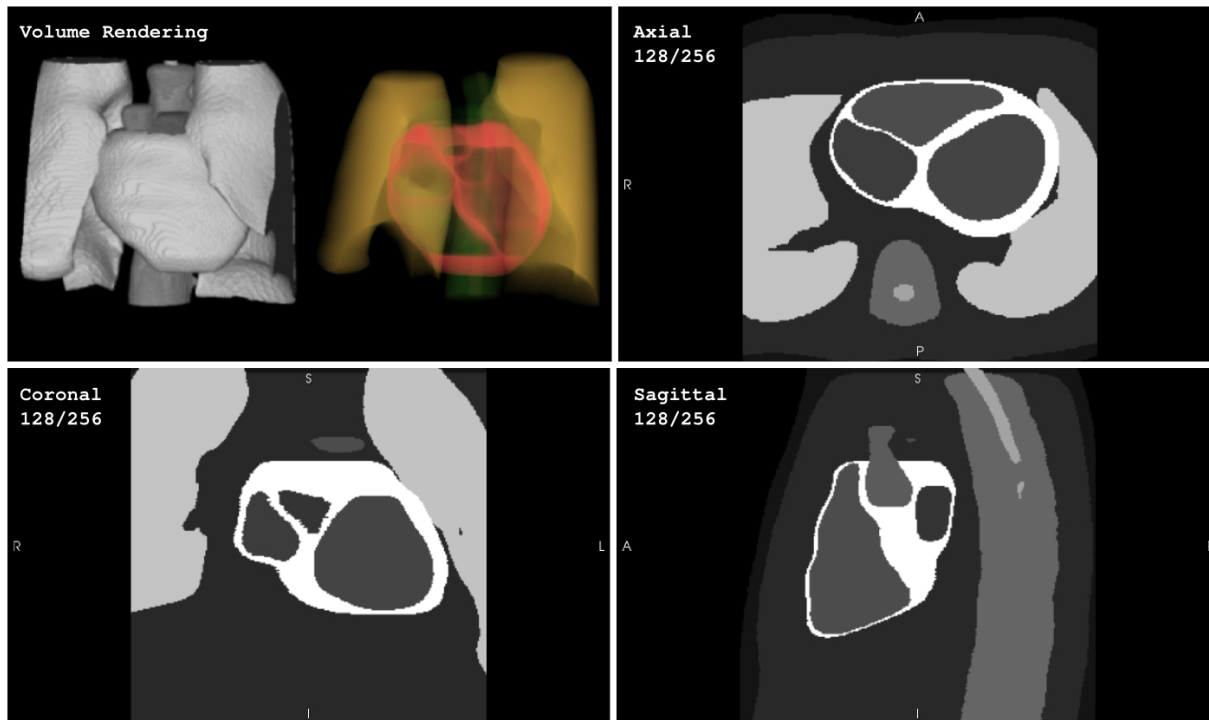
Application Software *SIMRI* – 3D MRI simulator based on the Bloch equation.

Website <http://www.simri.org>

Main Algorithm Solution to linear differential equation. (ODE solver).

VIP for VPH in action

Use Case Scenario – Model 1



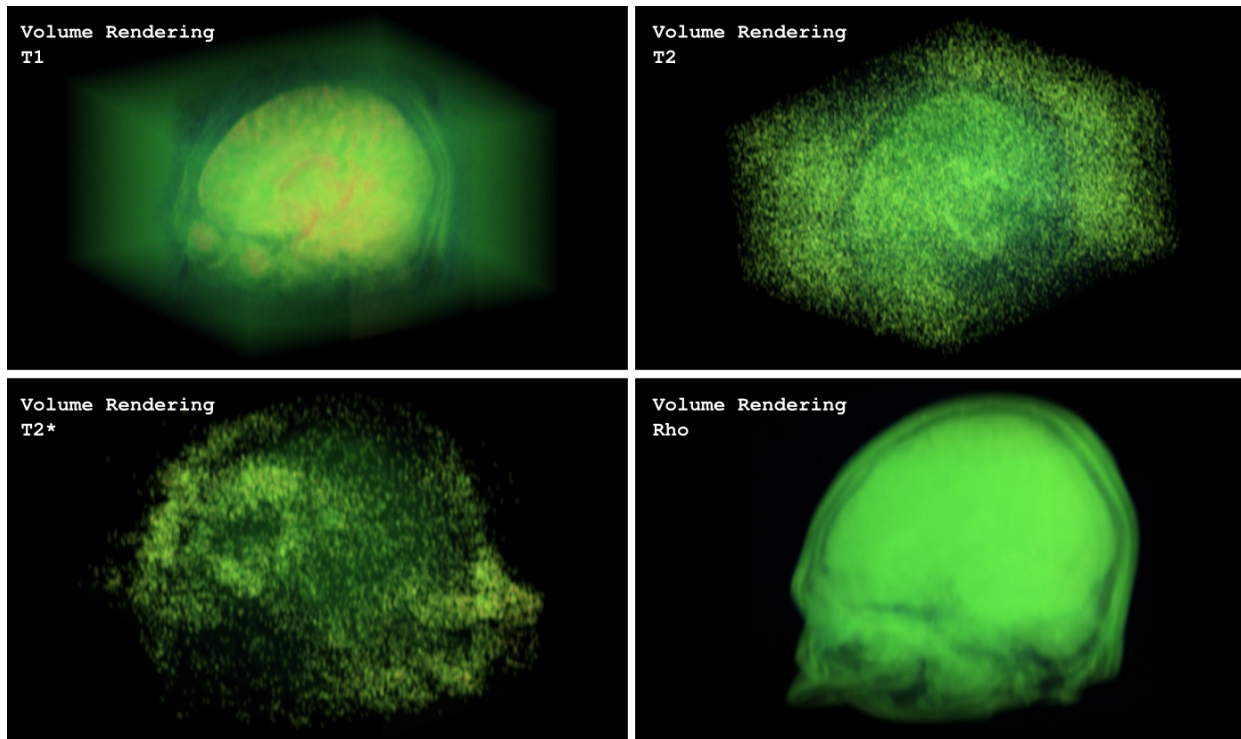
Model Heart
Object geometry labelled
with matter names and
physical values.

Model size 256x256x256

Computing time
(Estimated 1 CPU-Core) **769 days**

VIP for VPH in action

Use Case Scenario – Model 2



Model **Brain**

Relaxation time map
T1, T2, T2* and proton
density.

Model size 256x256x256

Computing time
(Estimated 1 CPU-Core) **769 days**

VIP for VPH in action

Log in

Virtual Imaging Platform

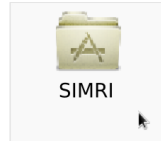
Email

Password

☒ Keep me logged in

[Create an account.](#)

Select



<http://vip.creatis.insa-lyon.fr>

Launch

SIMRI v0.4

Simulation Name

result directory
List


input zip file
List

Monitor


General Information

Properties	Value
Simulation Name	Large-Scale medical imagi
Simulation Identifier	workflow-YetPax
Submission Time	Fri Jul 20 16:03:01 GMT+200 2012
Owner	William A. ROMERO R.
Application	SimriAHE
Status	Completed

Simulation Logs



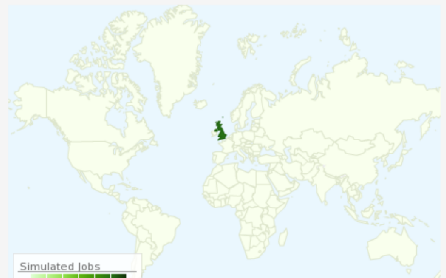
Output File




Error File

In/Output Data

Simulation Execution Location

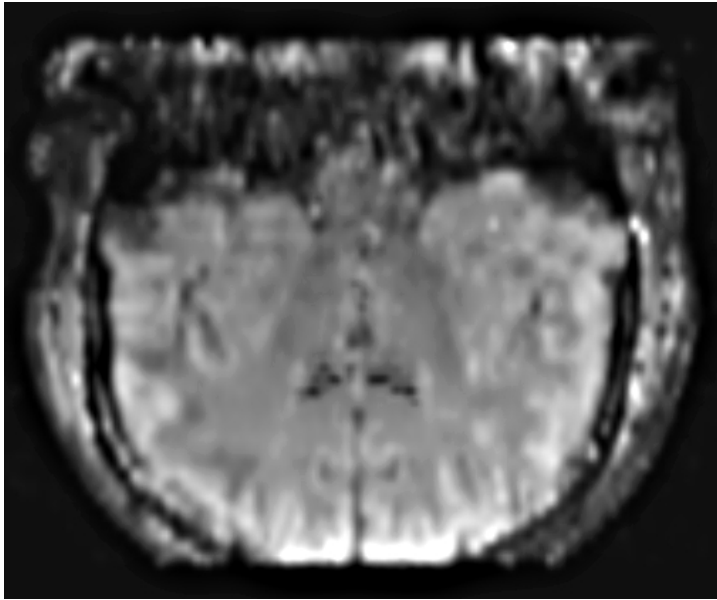


Simulated jobs
1  1



VIP for VPH in action

Use Case Scenario – Results

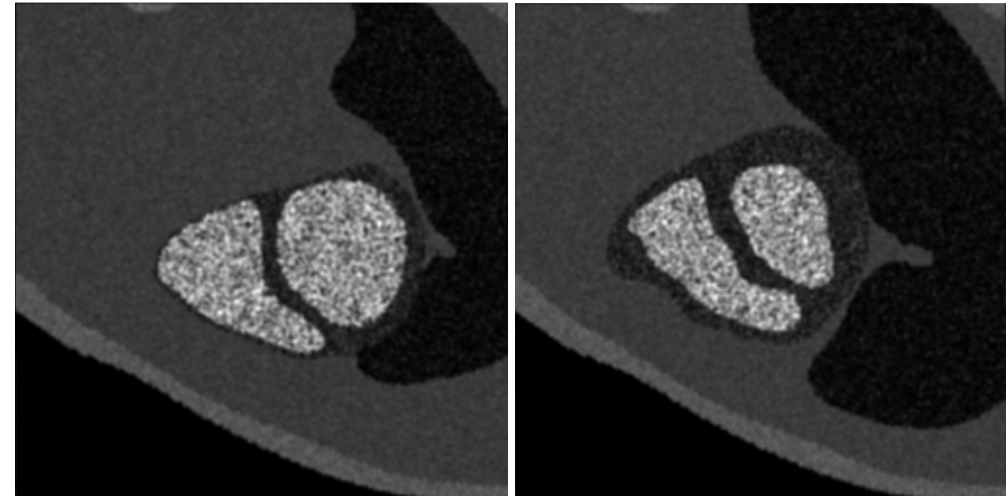


This image was preliminary to preparing a large-scale simulation based on the relaxation time maps model.

Model Brain
256x256x32

CPU-Cores 1024

Computing time **04h18**



A 2D MR balanced steady state free pre-cession (bSSFP) sequence at 1.5T was simulated on a cardiac cycle (14 instants) extracted from the ADAM model.



Model Heart
14 Instances

CPU-Cores 64

Computing time **7 min.**

Concluding remarks

- A reliable solution for MPI-Based applications is available to the VPH community based on VIP – AHE – PRACE.
- Available in the VPH toolkit.



Home » Virtual Imaging Platform (VIP)

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[input]
Password
[input]
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Navigation

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- Tools
- Methods
- Services

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Get involved
Toolkit Guidelines
Terms of use
Disclaimer & Privacy Policy

Latest entries

- Mimics Innovation Suite
- 3-matic
- Mimics
- CellML API
- gLite

Tag cloud

guidelines simulation cellml dicom imaging visualization
grid analysis video conferencing middleware audio conferencing
modelling data fusion workflow framework electrophysiology finite
element cardiac image distributed computing visualisation

VPH NoE Toolkit

Search

Virtual Imaging Platform (VIP)

Date added: 29.11.2011 **Hot Hits: 68**

Version: 0.7.7 mature

Submitter: [Frederic Cervenansky](#) [Mail](#)

License: ; Free for Academic use

Target user group: Researchers; Students; Industry; Any

Technology type: Online service

[Website](#)

Tags: [models](#), [ontologies](#), [simulation](#), [webgl](#), [RMI](#)

Categories: [Data Hosting Facilities](#) | [Model Repositories](#) | [How to access compute resources](#) | [Collaborative Services](#)

The Virtual Imaging Platform offers free, online access to simulators of medical images, namely Magnetic Resonance, Ultrasound, and Positron Emission Tomography. Radiotherapy simulations can also be conducted.

VIP has a repository of annotated organ models from which simulation can be designed. It relies on the European Grid Infrastructure (EGI) to store files and support simulations. It is being interfaced with PRACE to support MPI jobs. Computing and storage resources are totally hidden to the end-users.

<http://toolkit.vph-noe.eu>



Concluding remarks

- The VIP for VPH service empowers users with data and computing resources for:
 - Heavy simulations and heavy Image processing algorithms.
 - Tool for Hands-on learning/training.



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Q & A



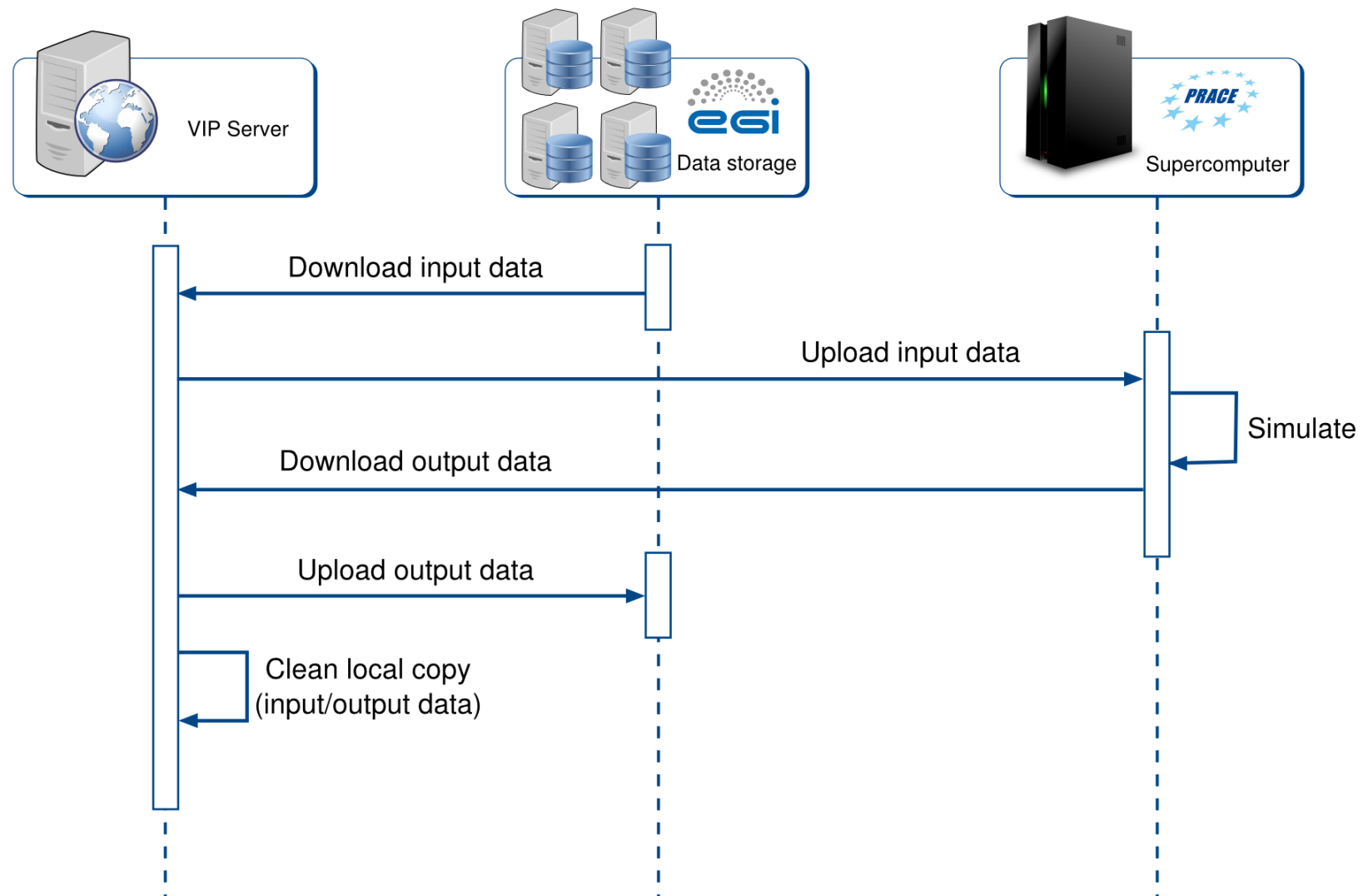
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Backup slides



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Data transfer



- Data transfer from the EGI data storage system to the target processing supercomputer.

PRACE - DECI-8 proposal

- The project has been granted access to a Tier-1 supercomputing provided by the Partnership for Advanced Computing in Europe – PRACE. This includes **1,670,670** standardized PRACE core-hours for MRI simulations.

Execution type	Model size	No. CPU Cores
Application testing protocol	256 ²	64
	128 ³	128
		256
		512
		1024
Production	256 ³	1024

VIP for VPH – Execution types

