

## BioMed

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### About

Biomed is a large-scale international Virtual Organization (VO) supporting communities from the Life Sciences sector focusing on three main groups: medical image analysis, bioinformatics and drug discovery. The biomed VO is operated on the EGI infrastructure and supported by 15 sites, delivering access to a large number of heterogeneous resources. In 2018, biomed users executed more than 2.5 million jobs corresponding to 439 years of CPU.

Overall, the primary objective of the biomed Community is to serve the European Life Sciences community in its exploitation of the e-Infrastructure service technology provided by EGI. More specifically, the community has the following missions:

- **Advance** and apply e-Infrastructure service technology for Life Sciences.
- **Represent** the Life Sciences users to negotiate resources, liaise with EGI and other worldwide resource providers.

- **Coordinate actions:** serve as a contact point for new users, share expertise, avoid replication of efforts, define domain-specific requirements, encourage sharing of resources, data and tools.
- **Provide technical support** for the operation and support common biomed Virtual Organisations, operate shared services, provide targeted user support and application porting.
- **Induction:** Co-organize community-specific training events that can smooth the learning curve and lower the start-up cost.
- **Dissemination:** transfer knowledge, advertize actions, and facilitate communication internally with the members and externally to other groups of interest (e.g., funding and policy-making initiatives).

## The VIP Platform

One of the flagship science gateways of biomed is the [Virtual Imaging Platform](#) (VIP). Through VIP, researchers can access multiple applications, as well as important amounts of storage and computing resources, without required technical skills beyond the use of a web browser.

VIP relies on the EGI DIRAC instance for job submission and data management on EGI biomed resources. The model has proved to be successful: VIP currently counts more than 1300 registered users, accessing 20 applications. Since 2011 we have logged dozens of peer-reviewed papers published with results computed through VIP.

The simplified workflow used to analyse medical imaging with VIP is shown in Fig.1:

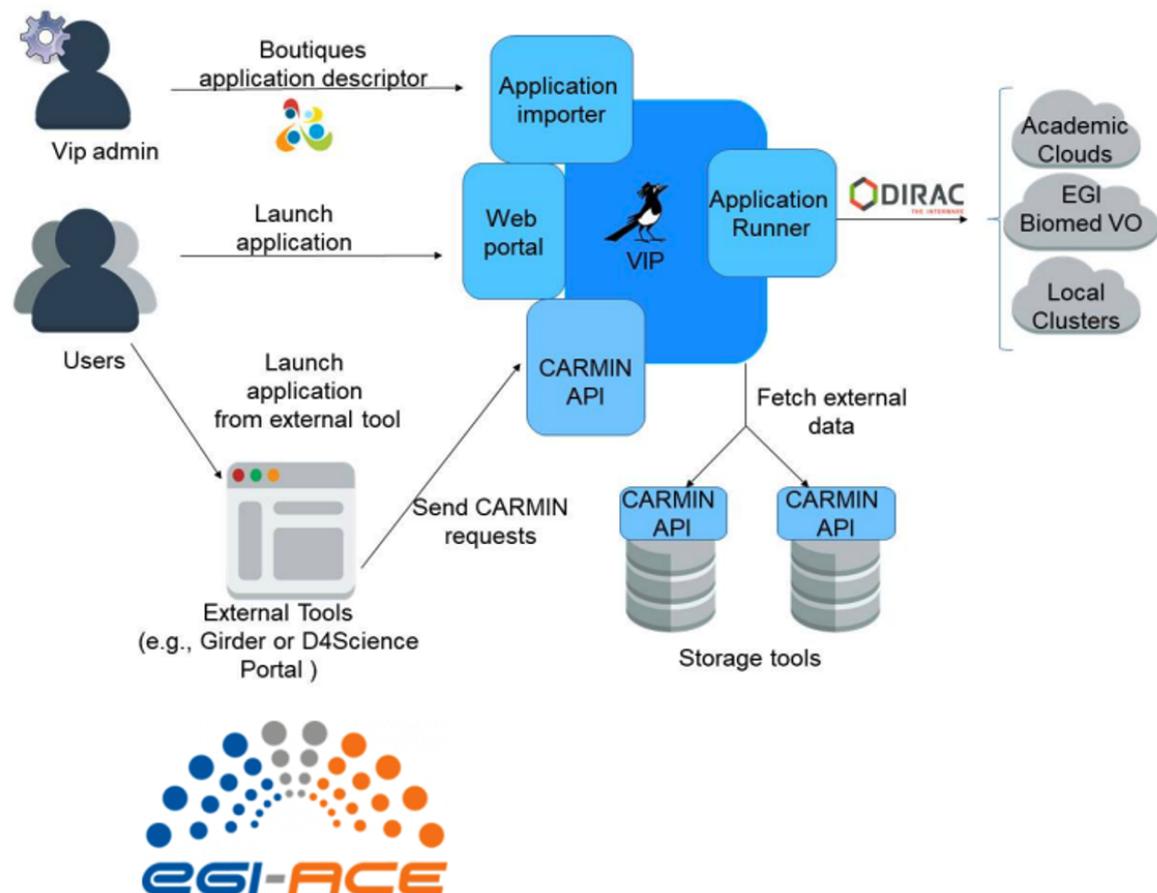


Fig. 1 - Workflow to access the Virtual Imaging Platform

- New applications are regularly imported in VIP by VIP admins, based on their [Boutiques](#) descriptors.
- Users can use VIP either through its user-friendly web-portal, or by using [CARMIN](#) (Common API for Research Medical Imaging Network)
- Once logged in, users have access to applications as a service, i.e., they can execute them as such, without bothering with their installation. Moreover, they benefit from the EGI computing resources in a transparent manner
- The VIP Workflow Engine generates and submits tasks (jobs) using Dirac, the EGI Workload Manager.
- The EGI Workload Manager pushes the user's jobs in one of the available resource providers of the EGI computing infrastructure for processing.
- Before starting the computation, input data is downloaded from the local/external storage on the computing node for processing.
- Results of the processing are uploaded to a storage accessible to the users, either through the VIP portal or external (storage) tools (thanks to the CARMIN API)

## The Challenge

VIP is now focusing on challenges concerning interoperability and reproducibility, in the larger scope of a FAIR approach to scientific data analysis. Through Boutiques, VIP is able to easily describe and integrate new applications, as well as publish them on open repositories, such as Zenodo, to make them findable and accessible. Through [CARMIN](#), VIP fosters data integration and interoperability among platforms. In the next few years, we can imagine a platform of platforms exchanging apps and data effortlessly. Re-usability of applications across platforms can be achieved with containers, which allow users to build applications on their desktops and run hundreds or even thousands of instances on remote CPUs.

## **EGI services used by VIP**

VIP uses the following EGI services:

- The [EGI Workload Manager](#) service which is based on DIRAC technology for distributing tasks (computing jobs) and access storage.
- EGI computing and storage resources such as the [EGI High-Throughput Compute](#) and the [EGI Online Storage](#) to distribute the computations.
- The support of a federated authentication mechanism based on the [EGI AAI Check-In](#) service is in progress.

## **Support from EGI**

The collaboration with EGI goes back to the Grid computing age. During the [EGEE project](#) series (2004-2010), a Virtual Research Community (VRC) was established and production services such as resource monitoring, user support and training have been set up and delivered to all users of the LSGC community in Europe, Asia and Latin America.

During the Cloud age, the VRC has been evolving to adopt the [EGI Cloud Compute](#) service solutions. Many of VRC platforms have been extended to run on the cloud providers of the EGI FedCloud.

## **Resource providers supporting biomed**

The distributed infrastructure supporting biomed, and therefore VIP, consists of resources from the National Grid Initiatives (NGIs), EGI, supercomputing platforms (DEISA), infrastructures potentially provided by ESFRIs, and other possible resources (e.g. commercial/private cloud resources). From the EGI Infrastructure, more specifically, **14** HTC and cloud resource providers are supporting the biomed community allocating computing and storage resources to serve the European Life Sciences community

In total **354 vCPU cores with 708 GB of RAM, including 1 GPU with 19 vCPU cores and 176 GB of RAM, and 10TB of Block Storage** are provided, bound with a Operational Level Agreement (OLA), by the following resource provider:

- [CREATIS-INSALYON](#), [IN2P3-CPPM](#), [IN2P3-IRES](#), [GRIF](#) and [OBSPM](#) from [NGI France](#)
- [INFN-BARI](#), [INFN-CATANIA](#), [INFN-FERRARA](#), [INFN-PISA](#) and [INFN-ROMA3](#) from [NGI IT](#)
- [NCG-INGRID-LP](#) from [NGI IBERGRID](#), and
- [BEIJING-LCG2](#) from [NGI\\_CHINA](#)

In addition, **443,6M HEPSPEC CPU/h** and **15.05 TB of storage** are provided, bound with a Operational Level Agreement, by the following resource providers:

- [IN2P3-IRES](#) from [NGI France](#)
- [INFN-PADOVA-STACK](#) from [NGI IT](#)
- [CESNET-MCC](#) from [NGI\\_CZ](#), and
- [CLOUDIFIN](#) from [NGI\\_RO](#).

In the context of [EGI-ACE](#), VIP is made visible by [EOSC Marketplace](#). The SLA agreement with EGI provider has been extended from January 2021 until June 2023 in order to support the continued operation of the lifescience platform as one of the EGI-ACE Data Space. For further details, about the collaboration agreement between EGI and LSGC, please check the [EGI documents repository](#).

## Impact - BiomedApplications in numbers

There are over **1,340** registered users to the VIP portal and 40% are from outside Europe. 80% of the VIP computing and storage are EGI resources.

## Usage of the EGI computing resources

Over the last 2 years (Dec. 2019 - May 2021) the Life Science Grid Community:

- Consumed more than **202,598** of (Cloud) CPU hours, **12,121,811** of (HTC) CPU hours and,
- Instantiated **94** VMs in the EGI Federated Cloud infrastructure.

## Publications

**12** publications have been produced with the support of EGI resources and services.

- [A medical imaging challenge on VIP](#), Sorina Camarasu-Pop, Axel Bonnet, Arthur Masson, Michael Kain, Michel Dojat, Olivier Commowick, Frédéric Cervenansky, Presentation in EGI Conference 2021, (2021)
- A Framework for the Generation of Realistic Synthetic Cardiac Ultrasound and Magnetic Resonance Imaging Sequences from the same Virtual Patients, [10.1109/TMI.2017.2708159](#)
- A preclinical simulated dataset of S-values and investigation of the impact of rescaled organ masses using the MOBY phantom, [10.1088/0031-9155/61/6/2333](#)

- Organ radiation exposure with EOS: GATE simulations versus TLD measurements, 10.1117/12.2217097
- A personalized, Monte Carlo-based method for internal dosimetric evaluation of radiopharmaceuticals in children, <https://doi.org/10.1002/mp.13055>
- Evolutionary constraints on polyembryony in parasitic wasps: a simulation model, 10.1111/oik.05479
- Exploiting GPUs on distributed infrastructures for medical imaging applications with VIP and DIRAC, [10.23919/MIPRO.2019.8757075](https://doi.org/10.23919/MIPRO.2019.8757075)
- Enabling Large Scale Data Production for OpenDose with GATE on the EGI Infrastructure, 10.1109/CCGRID.2019.00084
- Transcriptomic profiling of skeletal muscle adaptations to exercise and inactivity, <https://doi.org/10.1038/s41467-019-13869-w>
- A Multicenter Preclinical MRI Study: Definition of Rat Brain Relaxometry Reference Maps, <https://doi.org/10.3389/fninf.2020.00022>
- Framework for image quality and physical dose predictions of arbitrary CBCT source-detector trajectories with GATE, Conference on Image-Guided Interventions
- A Monte Carlo simulation framework for modelling Artis Zeego CBCT using GATE, Master Thesis

## Tutorial

<https://vip.creatis.insa-lyon.fr/documentation/>

## VIP in practice: creating a digital heart

Scientists from the University of Lyon used the VIP platform to develop a framework for generating virtual data to study heart diseases.

One 3D sequence took around **6** hours to generate on VIP. On a personal laptop, **280** hours would have been needed.



Read the full [use case](#).

## More information:

**Website:** <https://biomed.i3s.unice.fr/> and <https://vip.creatis.insa-lyon.fr/>

**VIP (in EOSC Marketplace)**

<https://marketplace.eosc-portal.eu/services/virtual-imaging-platform>

**VIP on GitHub:** <https://github.com/camarasu/VIP-portal>

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**EGI news:**

- <https://www.egi.eu/news/egi-and-lsgc-join-forces-to-support-life-sciences/>

- <https://www.egi.eu/news/lsgc-mobrain-nbis-and-terradue-service-agreements-renewed/>
- <https://www.egi.eu/about/newsletters/vip-and-the-biomed-community-achievements-and-new-challenges/>
- <https://www.egi.eu/use-cases/research-stories/creating-a-digital-heart/>