VirtualBrainCloud

Personalized Recommendations for Neurodegenerative Disease

Public deliverable report

D7.7: VBC operation report and published services on EOSC/EGI Marketplace

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List of Abbreviations

API	Application programming Interface
CHARITE	Charité Universitätsmedizin Berlin
CSCS	Swiss National Supercomputing Centre
EOSC	European Open Science Cloud
EUDAT	European Collaborative Data Infrastructure
fMRI	Functional magnetic resonance imaging
fMRIPrep	A Robust Preprocessing Pipeline for fMRI Data
FAIR	Findability, Accessibility, Interoperability and Reuse
FZJ	Forschungszentrum Jülich
HPC	High Performance Computing
I/O	Input/Output
JSC	Jülich Supercomputing Centre (part of FZJ)
JURECA	Jülich Research on Exascale Cluster Architectures
Fraunhofer SCAI	Fraunhofer institute for algorithms and scientific computing
MPI	Message Passing Interface
MRI	Magnetic Resonance Imaging
OLA	Operational Level Agreement
PRACE	Partnership for Advanced Computing in Europe
rqs	Requests per second
SDT	Service Description Template
SLA	Service Level Agreement
SLURM	Simple Linux Utility for Resource Management
TRL	Technology Readiness Level
TVB	The Virtual Brain
TVB-Cloud	H2020 project no 826421-VirtualBrainCloud
UNICORE	Uniform Interface to Computing Resources
VM	Virtual Machine

1. Introduction

The central goal of the TVB-Cloud project is the development of a Cloud-based platform, termed TVB-Cloud, for medical research that helps to improve early patient-specific diagnosis and treatment of neurodegenerative diseases like Alzheimer's disease and Parkinson's disease. Our long-term vision for TVB-Cloud to pave the way for a clinical product for personalized medicine that improves the quality of life of EU citizens by enabling targeted prevention, early diagnosis, disease progression prognosis, individual treatment plans, and development of novel therapies for neurodegenerative diseases with a focus on Alzheimer's and Parkinson's disease. We believe that this vision will be reached by implementing a European cloud-based platform that not only connects two critical streams of biomedical research, systems biology and computational neuroscience, but that also connects clinics, researchers, patients, and students. The platform is inherently designed to integrate and unify multi-modal multi-scale multi-source data and turn it into knowledge.

The central goals of Work Package 7 (WP7) in the TVB-Cloud project are enabling data and compute services in a dedicated cloud environment based on the European Open Science Cloud (EOSC), and the provision of cloud-based infrastructure environments which serve as data- and compute-backend for the development and software integration within the project.

In this deliverable, we want to cover two different things. On the one hand, it is intended as an interim report on the operational work performed in WP7, on the other hand, it is intended to provide information regarding the provision of services on the EOSC/EGI marketplace.

In Part I (chapter 2) of this deliverable we report about the work performed in the scope of WP7 - to operate, manage and maintain the provided infrastructure environments and services in the scope of TVB-Cloud. In section 2.1 we refer to the Operations on TVB-Cloud Infrastructure at SCAI. In section 2.2, we describe the operations of TVB-Cloud services at JSC.

In Part II (chapter 3), we follow on to elaborate and present opportunities to make certain TVB-Cloud services available on the European marketplaces of EOSC and EGI. Therefore, we first give some information on EGI and EOSC marketplaces (refer to section 3.1) and describe which benefits it may bring to join as a Service Provider (section 3.2). Subsequently, we summarize the onboarding processes and rules for joining the service portfolio of EOSC (section 3.3) and EGI (section 3.4). Finally, in chapter 4, we show a list of project service candidates in discussion to be published.

Note: The here mainly described services of WP7 comprise the developer infrastructure for TVB-Cloud. The production site of TVB-Cloud is the Virtual Research Environment (VRE) located at the Charité IT center (https://vre.charite.de/vre) providing General Data Protection Regulations (GDPR) compliant environment for the management, processing, and simulation of sensitive health data. In addition, TVB-Cloud coordinator Charité operates the Virtual Brain Cloud facility hub (https://www.humanbrainproject.eu/en/collaborate/facility-hubs/) at the EBRAINS Research Infrastructure (RI) to provide TVB-Cloud services with secure High Performance Computing (HPC) backend in a distributed EU wide infrastructure.

2. Part I: Operations Report

One important task WP7 is responsible for is the provision and management of cloud and HPC environments for the TVB-Cloud components. This includes the deployment, configuration, and operation of required infrastructure, system software, and specific TVB-Cloud-related components for development, testing, and training purposes. In the following sections, we report on the work carried out at SCAI (2.1) and JSC (2.2). In both chapters, we focus on the work performed during the last reporting period to avoid repetition of information from previous deliverables and reports.

2.1 Operations on TVB-Cloud Infrastructure at SCAI

The TVB infrastructure and its services, established under this project in previous tasks, are in operation and used extensively. This, for example, includes the brain simulator software from The Virtual Brain project[1], Gitlab CE[2], Nextcloud[3], JupyterHub and the data management platform Blue Brain Nexus[4].
Moreover, a TVB-Wiki[5] and a TVB helpdesk/ticket system based on Zammad[6] were deployed.
For authentication, we use the components of Keycloak[7] as a Single-Sign-On solution with identity federation, and FreeIPA for identity provision and system-level access. To monitor the services, we use the combination of Prometheus[8] and Grafana[9], where Prometheus acts as the storage backend and Grafana as the interface for analysis and visualization. To centrally manage and analyse the various logging data, TVB-Cloud uses the software Graylog[10].
An overview of the offered services and the individual components of the TVB-infrastructure can be seen below in Figure 1.

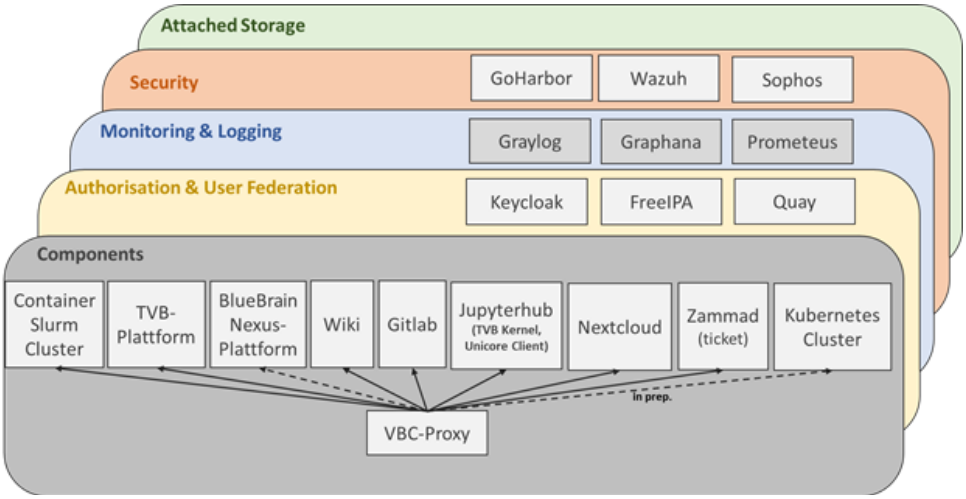

Figure 1: TVB-Cloud testbed

[1] https://vbctvb.scai.fraunhofer.de/user/
[2] https://gity.scai.fraunhofer.de/users/sign_in
[3] https://cirrus-vbc.scai.fraunhofer.de/index.php/login
[4] https://bluebrainnexus.io/docs/
[5] https://wikidev-vbc.scai.fraunhofer.de/auth/login
[6] https://tickets.scai.fraunhofer.de/#login
[7] https://vbcauth.scai.fraunhofer.de/auth/
[8] https://prometheus.io/
[9] https://grafana.com/docs/grafana/v7.5/dashboards/
[10] https://www.graylog.org/

To ensure smooth and failure-free operations, functionality, and load tests of the web applications and services are carried out. Furthermore, the performance, stability, and effectiveness of the basic TVB-Cloud infrastructure components were benchmarked.
One of the benchmarks that were run was to measure a typical workload of the TVB Nextcloud[11] service for sharing data. This was done with the Gatling[12] tool, which is used to benchmark the usage of a service. In the test, we simulated typical user activities as file opening and browsing through menus for 20 users in parallel. The results can be seen in Figure 2, which is seen below.

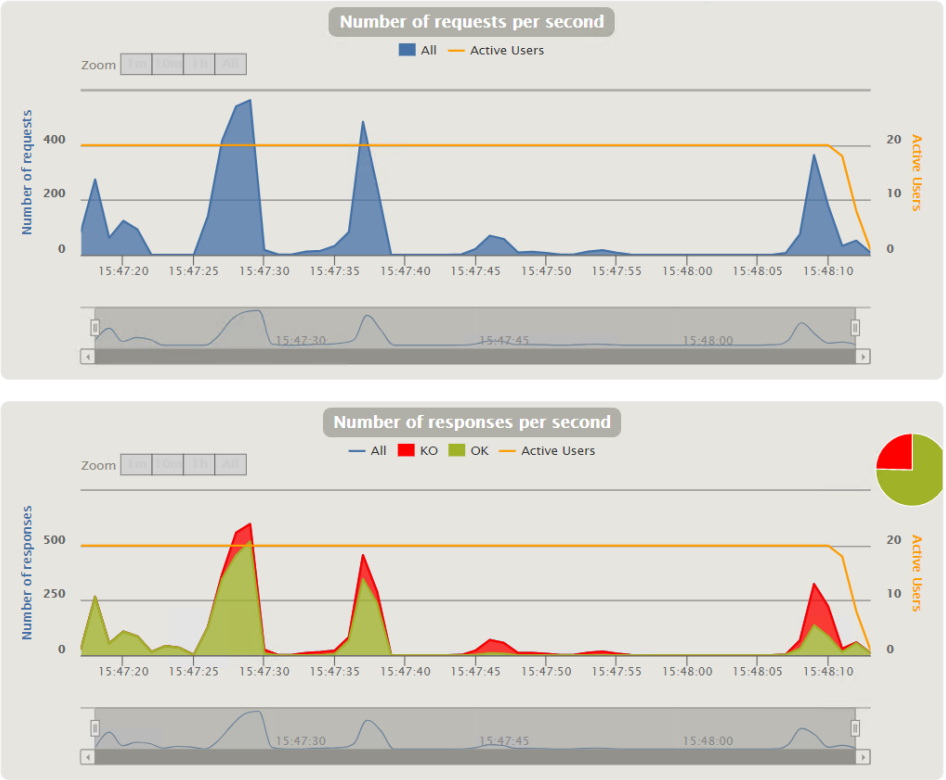

Figure 2: Data sharing Nextcloud results from Gatling benchmark

Moreover, some stress tests were executed with htstress[13] on the Nginx, HTTPS reverse proxy (VBC proxy), which takes a client request and passes it to a server. Htstress allowed us performance testing with a high number of requests per second (rqs). During one test we made 1,000,000 requests with a concurrency of 100 and received 100% good requests with 15433.390 requests per second.
In Figure 3 below, you can see some snapshots of the Grafana Dashboard, showing the load of the system during this exemplary stress test.

[11] https://nextcloud.com/
[12] https://gatling.io/
[13] https://github.com/arut/htstress/blob/master/README

Figure 3: Results during a stress test - Grafana

Furthermore, progress was made in the design and development of a web service backend that serves as a gateway to Supercomputer/HPC resources. The next phases of development will be continued by the departments of JSC. It supports different HPC workload managers (currently SLURM[14] and Unicore[15]). As part of WP7, an adapter class was defined to solve the provisioning of multiple HPC workload managers. The adapter class acts as an abstraction layer in between the user application and the backend for the HPC workload.

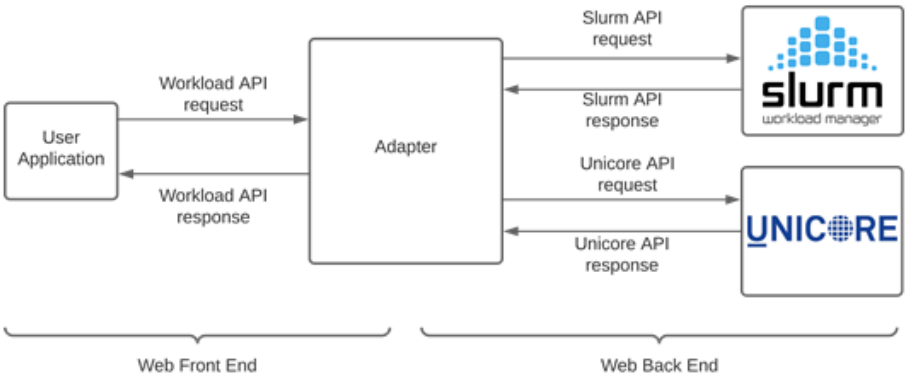

Figure 4: Gateway to HPC Resources

One of the main advantages of the adapter will be the support of the newly available slurm REST API[16] and UNICORE. slurm is a workload manager for HPC systems, which is used by many HPC sites. The adapter will simplify the development of end-user applications or views in web applications and open the direct use of in-house HPC resources at local and remote resources. The adapter will also include an encryption model to secure data end-to-end. The adapter is currently in the 1st testing phase and is expected to be operational soon.

[14] https://slurm.schedmd.com
[15] https://www.unicore.eu/
[16] https://slurm.schedmd.com/rest_api.htm

In addition, an OSC OnDemand HPC portal[17] is now provided at Fraunhofer SCAI as a further solution for users to access HPC resources. The OnDemand[18] the portal is an interactive interface to remote computing resources and simplifies the access to HPC resources. Moreover, a variety of applications are available through the portal, e.g. it supports a JupyterHub on HPC systems. The OnDemand can be easily extended with further desired applications or services from the TVB-Cloud project.

2.2 Operations of TVB-Cloud services at JSC

We support the migration of pre-processing workflows from JURECA to JURECA-DC and JUSUF with software installations and support for writing computing time proposals. We are continuously supporting the creation of Singularity containers, which form parts of the pre-processing pipelines for anatomical and functional data in the JSC, including fMRIPrep and CAT[19]. Specific software packages required for these pipelines like FSL[20] are also in the process of being installed as modules in JUSUF and JURECA-DC. Additionally, the installation has been tested for the main TVB scientific library using the latest stage of software both in JUSUF and JURECA-DC.

There has also been a support to consortium members for optimized performance of Bayesian inference code. Tests and integration with the Learning to Learn (L2L) framework [21]were performed on JUSUF. Unfortunately, inference simulations need long computation times, so these jobs need to be executed in the long queue of the CSCS computing cluster. We have provided temporary access to CSCS for consortium members for testing, but there is no solution for this on the HPC side of JUSUF. The only alternative is running the jobs directly on a virtual machine at the cloud partition. Following this directive, the setup of service for Bayesian inference is planned in the following months.

On the JUSUF cloud, there are test installations in the final phase of preparation for the main TVB framework including the L2L integration with simple TVB simulations which allow efficient and adaptive parameter optimizations on HPC using an MPI parallelization strategy. Access and support to the pre-production instance is currently restricted to TVB Cloud consortium members who want to make use of this service and are available under demand.

IPython notebooks on the HBP Collaboratory have also been prepared to show the connection between L2L and TVB using UNICORE to deploy jobs on HPC (contact[22])

3. Part II: EOSC/EGI Marketplace

Here we will discuss how certain services of the TVB-Cloud project can be provided on EOSC and EGI Marketplace.

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[17] https://draco-ondemand.scai.fraunhofer.de

[18] https://openondemand.org/

[19] https://fmriprep.org/en/stable/

[20] http://humanbrainmapping.org/files/2016/ED/Course%20Materials/Anatomy_Jenkinson_Mark.pdf

[21] https://gitlab.jsc.fz-juelich.de/diaz1/icei_demonstrator_l2l/tree/master

[22] S.diaz@fz-juelich.de

A large number of new potential services for the neuroscience community are still under development in the TVB-Cloud project. We will present a detailed list at the end of this deliverable.
Since WP7 as an infrastructure provider does not develop any independent services in the scope of TVB-Cloud, WP7 can only offer support in the process of service onboarding to other project partners. Thereby, Fraunhofer SCAI and JSC may benefit from long-lasting relations to the associated communities. In this context, service onboarding means the process of joining service to the portfolio and service offerings of the marketplaces.

In the context of the European Open Science Cloud, a marketplace and a service catalogue are made operational. Besides, it is also possible to publish services on the marketplace of the EGI.eu infrastructure. The EGI Federated Cloud[23] resources may be used to host services published on the EOSC Marketplace.

At this point, it is important to mention, that the services of the project are still published throughout thevirtualbrain.org [24]. These services encompass TVB software and available data.

In the following sections, we will briefly introduce both ways which is also a short introduction for those who are not familiar with EOSC Marketplace.

3.1 What is EGI/EOSC Marketplace?[25]

The idea of a Pan-European distributed infrastructure, offering resources and services for data-intensive processing in research, has already been part of the vision of EGI since 2000. This commenced when initial projects such as DATA Grid had started.
In 2015, this idea was taken up and further developed by the idea of a European Open Science Cloud, building a virtual environment for researchers to store, manage, analyze and re-use data for research, innovation, and educational purposes. In this connection, EGI together with the initiatives EUDAT, Indigo-DataCloud and other major European research infrastructures committed to supporting the implementation of EOSC.
Out of this history, two similar but different online platforms have emerged, offering researchers the chance to discover easily and efficiently, access, use and reuse a wide range of resources and services. On the one hand the EGI Marketplace and on the other hand the EOSC Marketplace, of which the latter one also provides services under the branding of EGI.
Although both marketplaces serve the same purpose, namely the provision of all necessary functionalities for bringing together offering and demand to make research happen, there are somewhat different requirements and procedures for service providers to onboard their services.

3.2 What benefits does it bring to join as Service Provider?

For service providers, there are some advantages by contributing their services/resources to such online marketplaces. The first one is the possibility to display services on an internationally recognized platform and to grow the user base of service by promoting its adoption to new communities. A second benefit is that Service Providers get statistics about access requests and receive regular and constructive customer feedback from users of different fields of research.

[23] https://www.egi.eu/federation/egi-federated-cloud/
[24] https://www.thevirtualbrain.org/tvb/zwei
[25] https://www.egi.eu/wp-content/uploads/2019/10/Inspired-Issue-35.pdf

Furthermore, EGI/EOSC offers support to leverage and integrate with federation services to improve their own services. The online platform e.g., can help to easily manage service requests, interact with users, and provide support to them, to handle the accounting as well as to manage authentication and authorization of users and future users of delivered services.
Altogether, participation and involvement in these initiatives enable collaboration with other organizations, to increase the exploitability and innovation capacity of service offerings and offer different possibilities to participate in the development of these heavily subsidized initiatives (esp. EOSC).

3.3 Onboarding Process and Rules for participation in EOSC Marketplace

In the next two subsections, we will shortly present the procedures for onboarding services to EOSC and EGI Marketplace. To start, we first summarize the procedure for EOSC, which is in alignment with the Service Portfolio Management (SPM) process of the EOSC IT Service Management System (SMS) developed in the scope of the EOSC-hub[26].

As a prerequisite for the registration of services to the EOSC Portal/Marketplace, there are diverse fundamental requirements and rules for participation. The "Integration handbook for service providers"[26] e.g., stated the following fundamental requirements:

1. The service falls within the remit of the EOSC activities, i.e., it brings value to users and facilitates them to implement Open Science.
2. It is either an online service (e.g., a web application portal, a web service) or a 'human' service, such as training and consultancy (plain datasets and software artifacts should not be directly onboarded to EOSC. There are other ways to do that.)
3. The service is mature, reaching 'Technology Readiness Level 7 (TRL7)'. TRL7 services are 'System prototype demonstration in operational environment', practically meaning that they have been already used by early adopter scientists.
4. The compulsory fields of the service description template are filled during onboarding.

On the EOSC portal, the following conditions are required[27]:

1. The service is accessible by users outside its original community.
2. The service is described through a common template focused on value proposition and functional capabilities.
3. At least one service instance is running in a production environment available to the user community.
4. Publish Research data is Findable, Accessible, Interoperable, and Reusable [reference to FAIR].
5. Release notes and sufficient documentation are available.
6. Helpdesk channels are available for support, bug reporting, and requirements gathering.

In the presentation "EOSC Portal Service onboarding and Rules of participation"[28] by Mark van de Sanden, the following minimal set of rules was defined:

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[26] https://www.eosc-portal.eu/sites/default/files/EOSC-hub%20Integration%20Handbook%20for%20Service%20Providers.pdf

[27] https://eosc-portal.eu/for-providers

[28] https://de.slideshare.net/TheEOSChubproject/overview-of-the-onboarding-and-validation-process-and-the-rules-of-participation-from-a-service-provider-point-of-view

1. Main Rule: EOSC services shall be registered in an EOSC compliant or compatible service catalogue visible to the global EOSC Gateway.
2. Machine-readable metadata: EOSC Services must be described in machine-readable format by means of common and persistent identification.
3. Portability: Whenever possible, the service provider should support and enable the portability of data and services.
4. Terms of Use: EOSC services must have Terms of Use including Access and Data Policies
5. Access Model: Service providers may apply users' changes/fees, which could vary by type of service, type of service provider, and location of users.
6. Accessibility: EOSC service providers must describe how they ensure accessibility and interoperability, e.g., their metadata, APIs, standards, protocols
7. Quality of Service: Service providers should adhere to a minimal set of quality guidelines, these may include TRL and certain certifications.

To verify that a service satisfies all these prerequisites, it must pass the onboarding process for services joining the Service Portfolio. To illustrate this procedure, the EOSC provides the following diagram.

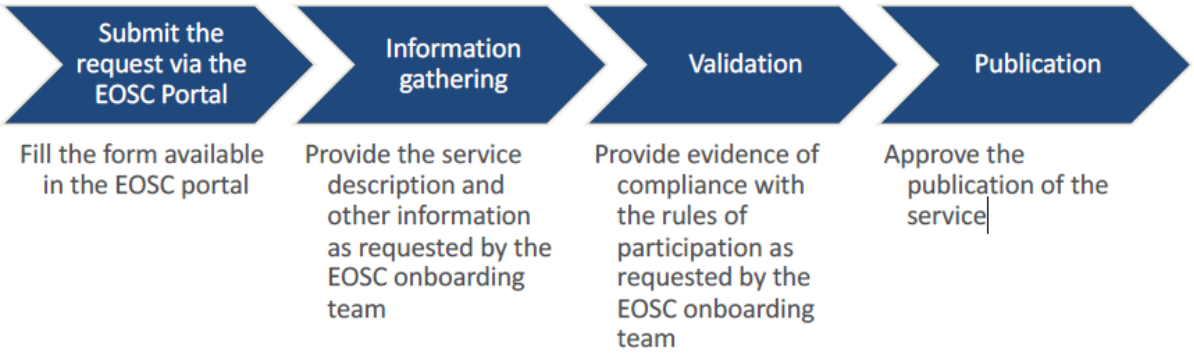

Figure 5: General overview of the steps

The point of entry for an interested service proposer is the EOSC providers portal[29] and choose "Onboarding of Resources[30]". After learning more about the chosen option the proposer proceeds by selecting "Apply now" at the end of the page.
Access either with the credential of your research organization listed in the table shown on the website or with your company's or private account (e.g. a Google account is possible). Filling out the online form[31] is part of phase one of the three phases for the onboarding process. The second phase is for updating the provider information and the third phase involves the provider offering resources. As soon as each phase is approved, the user is notified to proceed accordingly. If the three-phase onboarding process is successful, then the provider is registered to the EOSC Portal and the resources offered by the provider are publicly accessible. We recommend to inform yourself about the detailed 10-steps onboarding process at EOSC Provider Portal – Basic Guide [32]. The 10-steps sounds more complicated as it is. However, all steps are very well documented.

[29] https://providers.eosc-portal.eu/
[30] https://providers.eosc-portal.eu/becomeAProvider
[31] https://providers.eosc-portal.eu/provider/add/
[32] https://eosc-portal.eu/providers-documentation/eosc-provider-portal-basic-guide

Reaching the published status in the EOSC Portal and Marketplace is the minimum level of EOSC integration. But next to the portal registration, EOSC offers additional integration options. Those additional integrations are optional but can bring further added value to providers and users which include the integration with the federated user authentication, available and reliable monitoring services, the accounting service, the EOSC Helpdesk, and the integration with the various services to manage research data more easily (e.g., B2Drop, B2Share, B2Find, etc.). More detailed information on this can be found in the "Integration handbook for service providers" published by EOSC-hub.

3.4 Onboarding Process and Rules for participation in EGI Marketplace

Now, we will sketch out briefly the procedure for onboarding services to EGI Marketplace[33]. Thereby, we primarily stick to the information presented by Diego Scardaci and Matti Heikkurinen at EGI Conference 2020[34].
Altogether, EGI offers two possibilities to onboard your services, on the one hand, the standard way and on the other hand a new way offering a more lightweight integration with EGI.

Like the process for EOSC, the standard way is based on the Service Portfolio Management (SPM) process of the EGI SMS and uses the Service Design Transition Package (SDTP), which step by step must be completed by the SP to propose a new service. To support the SP, EGI offers a guide providing instructions to complete the SDTP. Both Documents are provided in Annex I and Annex II.

In the first step, the section “Value Proposition Design” of the SDTP must be completed. It is the minimum set of information required by the Service and Solutions Board (SSB) to be able to review and provide feedback for the proposal.
In the second step, section 2 “Business Case Design” needs to be completed. Both sections 1 and 2, are following given to the EGI Executive Board by the EGI.eu Director or Technical Director.
Once the service is endorsed by the EGI Executive Board and EGI Council, in the last step sections 3 “Service Design” and 4 “Service Transition Plan” must be completed by the service owner.
As soon as the onboarding process is successfully finished, the service is added to the EGI service portfolio and becomes publicly accessible at the EGI website, the EGI Marketplace, and the EOSC Portal & Marketplace. After the cooperation between EGI, the service provider, and users are defined by respective OLAs/SLAs, the service is offered with an EGI brand and managed according to the processes of the EGI ITSM.

The new way of onboarding provided by EGI is based on the provision of a new catalog of external/community services, that are more lightweight integrated with EGI. In concrete, this means, that service providers preserve the branding, and enter into direct interactions with customers. This possibility requires weaker conditions to be satisfied.

3.5 EGI vs EOSC

Within the framework of TVB-Cloud, we suggest first trying to make the chosen services available on the EOSC Marketplace. There, it is possible in a first step to register and publish the service on the marketplace and, independently of this, to integrate them in a second step with the already offered

[33] https://marketplace.egi.eu/
[34] https://indico.egi.eu/event/5000/sessions/4521/#20201104

service offerings like e.g., the federated user authentication, monitoring services, accounting service, etc. Furthermore, the onboarding process at EOSC seems to us to be very well documented.

In direct comparison with this, the onboarding process at EGI seems to be a bit stricter and more extensive at the moment. However, as mentioned above, EGI is working on a further possibility to add external services to their portfolio, which are more lightweight integrated and require weaker conditions to be satisfied. As soon as this possibility is available, the publication at EGI can also be taken up.

4. TVB-Cloud Services

In this chapter, we start a preliminary list of services under the umbrella of the TVB-Cloud Project. This list will be transferred to an available catalog at the end of the project.

Table 1: List of potential TVB-Cloud services

Services	**Provided by/ running at**	**Short Service description (& related link to further information)**
Cloud-test-Infrastructure	SCAI	Prototyping cloud infrastructure operated at Fraunhofer SCAI. Various services operated in this cloud are accessible through Web Interface or APIs (such as a file exchange Service based on Nextcloud, thevirtualbrain service, etc.). IaaS cloud can be operated through Web Dashboard (OpenStack Horizon) or OpenStack APIs and the various available libraries.
HPC Access	JSC	Access to High-Performance Computing resources at the Jülich Supercomputing Center are through the UNICORE system. Accessible through a desktop Client (Unicore Client) and REST APIs. A Python library is available to facilitate access from code.
E-Brains Services	Ebrains.eu	EBRAINS research infrastructure developed by the Human Brain Project. EBRAINS offers various services including data catalogue, brain atlases, different simulators, and more. See ebrains.eu or wiki.ebrains.eu [35]for more information. Accessible through the interactive web interface.
CTS2	University Genoa	Prototype Service implementing the Common Terminology Services 2 (CTS2) OMG/HL7 Standard to fully support the management of semantics in the exchange of clinical information structured through independent organisations[36].
ComPath	SCAI	An integrative and extensible web application for exploring, comparing, and curating pathway

[35] https://ebrains.eu/

[36] http://www.medinfo.dibris.unige.it/VBC_CTS2/

Services	Provided by/ running at	Short Service description (& related link to further information)
		databases. Accessible through an interactive web interface and RESTful API.
SCAIView	SCAI	The information retrieval system SCAIView allows for semantic searches in large text collections by combining free text searches with the ontological representations of entities derived by ProMiner. Accessible through an interactive web interface and RESTful API.
SAM	SCAI	Event triggering (selecting a brain region in the 3D visualization of BrainX3) activates the Semantic Aggregation Machinery's concept view component of SCAI.Bio web view components and fetches the corresponding brain region information. Accessible through an interactive web interface and RESTful API.
The Virtual Brain	Thevirtualbrain.org	TheVirtualBrain Brain Simulator[37], can be used as a desktop application or service in one of the previously mentioned infrastructures.
TVB Image Processing Pipeline	Tvb-pipeline.apps.hbp.eu	Various pipelines to (pre-)process data, such as the TVB pipeline and more. https://github.com/BrainModes/*
L2L parameter optimization for TVB	JSC	Machine learning tools for parallel HPC compatible parameter optimization of different TVB models.
Bayesian inference	JSC/CSCS	Tools for bayesian inference of epileptogenic parameters in whole brain simulations.
Virtual Research Environment (VRE) [38]/ Health Data Cloud (HDC)[39]	CHARITE/EBRAINS	GDPR compliant infrastructure with HPC backend for complex processing of sensitive health data
Virtual Brain Cloud Facility Hub[40]	CHARITE/EBRAINS	GDPR compliant TVB-Cloud end-to-end workflows on EBRAINS RI

We presented the above table in one of our internal deliverables to be discussed with the partners as potential candidates for the above-described marketplaces.

Not all services in the project are operational with a high TRL. Some of them are accessible locally at partner sites on a basis of "as it is." Mostly, there are complex scientific workflows behind the web-enabled applications performed on larger local cloud infrastructures – e.g., Openstack, HPC, and

[37] https://www.thevirtualbrain.org/
[38] https://vre.charite.de/vre
[39] https://www.healthdatacloud.eu/
[40] https://www.humanbrainproject.eu/en/collaborate/facility-hubs/

Kubernetes clusters with large storage systems. Data value is produced by complex data derivation processing by a variety of data resources.

When using any basic infrastructure at any place, provisioning such a service brings out compliance questions surrounding data protection, licensing, export control, and organizational regulations. Thus, the scientist will have reservations about offering such a service under the conditions of the above marketplaces.

As already mentioned, WP7 as an infrastructure provider does not develop any independent services, that could be offered on one of the two presented marketplaces.

Nevertheless, in the scope of WP7, we have tried to identify a service candidate as an example with whom we can enter the onboarding process described above. This candidate is the SCAIView service, which is an information retrieval system that allows for semantic searches in large text collections by combining free text searches with the ontological representations of entities derived by ProMiner.

In parallel to our ambitions to publish the SCAIView service on the EOSC Marketplace, we will also continue to see whether other services that are currently being developed in the other WPs of TVB-Cloud could turn out to be potential candidates. Though, some of these services are strongly linked to the input data (health data), which makes publication on a public marketplace difficult.

In these cases, it seems only possible to make the developed services available as locally installable software packages, where users would have to use their own data sets. However, such a software repository is not yet offered by EOSC and EGI. It should be possible in the future to publish software packages in a repository provided by EOSC/EGI, also the desktop application BrainX would be a potential candidate.

The testbed service today at SCAI has also the potential to operate the complete infrastructure at EOSC with EGI FedCloud resources[41].

5. Conclusion and next steps

In Part I, we have shown the infrastructure that was provided for the project teams from the beginning of the project by Work Package 7. The project is internally using and working with other Infrastructures. It is worth mentioning that BIH/Charité Virtual Research Infrastructure (VRE)[42] operated at Charité, where services from the project are directly integrated (see for example deliverables of Work Package 6 and BrainX). Also, the Human Brain Project's Fenix infrastructure [43]which is operated by PRACE is used by the partners of the project.
It is planned to transfer the test infrastructure for further use to the EOSC/EGI FedCloud.

[41] https://www.egi.eu/federation/egi-federated-cloud/

[42] https://brainsimulation.charite.de/en/forschung/

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There is strong discussion and interest in the project on how and in which way research results are presented as a service at the EOSC marketplace. The aforementioned developments are mostly available and accessible as web-based applications or provide a REST API. However, the rules for publishing these services on the marketplace can be extremely strict, and organizational, licensing and data protection regulations can thus present barriers to the inclusion of these services. Some of them are still published at the very active site thevirtualbrain.org or available via the EBRAINS infrastructure[44].

6. References

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