



## Virtual European Solar & Planetary Access (VESPA) □ 2021: consolidation

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VESPA (Virtual European Solar and Planetary Access) has been focusing for nearly 10 years on adapting Virtual Observatory (VO) techniques to handle Planetary Science data [1] [2]. The objective of this activity is to build a contributive data distribution system where data services are located and maintained in research institutes, as well as in space agencies and observatories. This system is responsive to the new paradigm of Open Science and FAIR access to the data.

During the previous Europlanet-2020 program, VESPA has defined an architecture adapted from the astronomy VO, incorporating concepts and standards from other areas (Earth observation, Heliophysics, etc). The basic system uses the VO infrastructure: data services are installed in any location but are declared in a system of harvested registries with identifiers, end-point (URL), mention of supported access protocols, and rough description of content. Such services are interoperable via clients and tools, which also provide visualization and analysis functions.

The activity in Europlanet-2024 focuses on expanding this environment, enforcing sustainability, and opening new possibilities to improve data processing – such as workflows, cloud-based computation, and readiness for exploitation through Machine Learning techniques.

**Data access.** VESPA has defined a specific access protocol called EPN-TAP which at the time of writing is a Working Draft of the Internal Virtual Observatory Alliance (IVOA), and expected to become a Recommendation in the coming months [3]. The EPN-TAP metadata system provides uniform description of datasets not only to access data in a VO context, but also for research projects. EPN-TAP is compliant with the general TAP protocol, allowing usage of existing VO tools and communication protocols with data services pertaining to Solar System studies. Some VO tools (TOPCAT, Aladin, CASSIS) were also adapted to improve the handling of such data.

The VESPA portal, intended as a discovery tool to browse the EPN-TAP services, is under study to improve the user experience. Elasticsearch capacities are being implemented, and all interface mechanisms are being evaluated. Other, more specific access modes (via script, web services, VO tools, etc) are also being reviewed.

**Data services.** There are currently 55 EPN-TAP data services published in the IVOA registry, and about 20 in development phase. Most of them are implemented on DaCHS, a VO data server provided by Heidelberg University. A major upgrade of DaCHS published last year implements recent evolutions of IVOA standards. Existing data services are currently reviewed for compliance, and upgraded to benefit from the latest developments. In many cases, this is also an occasion to extend

their content with new data. This upgrade also addresses low-level technical aspects, e.g. related to declaration in the IVOA registry.

Larger data infrastructures with EPN-TAP interface (AMDA, SSHADE, PVOL) also continue to develop their content and capacities, e.g. band lists have been implemented in SSHADE this year.

**Sustainability.** This major update relies on the VESPA hubs activity: definition files of all services are stored in a unique gitlab for preservation and maintenance by several VESPA teams. Authentication is granted by GÉANT/eduTEAMS. This is a simple and efficient way to share the technical expertise among services and teams, and to improve sustainability.

**New environments.** VESPA-cloud was a project supported by EOSC-Hub, through its 2nd Early Adopter Program (2020-21). It was an assessment of the deployment of EPN-TAP services on EOSC (the recent European Open Science Cloud) inside Virtual Machines or Docker containers, from the same gitlab installation used to preserve the services. The assessment was successful and opens up new solutions and opportunities for future VESPA service implementations. It will provide a workaround to services temporary unavailability, for performing cloud-based computation on data services, and a solution for data providers who are not able or not willing to host a VESPA server for a long period of time.

**New services.** Implementation of new services has been going on with internal projects. External ones will restart with an on-line implementation workshop before the end of the year. A Vizier EPN-TAP service will provide access to the data content of articles related to the Solar System and exoplanets (hopefully ready at the time of the conference). An interface with space agency archives will make use of the recent PDS4 dictionary for EPN-TAP (in addition to the existing EPN-TAP interface on ESA's PSA).

Discussions have started with other WP producing data in Europlanet-2024 to start distributing their results using the VESPA infrastructure: other VAs (SPIDER, GMap, ML), NA2 (telescope network), and TAs (lab experiments and field studies). VESPA is of course also available to distribute data from other H2020 programmes in the field.

**Prospects.** Detailed examples of recent VESPA developments are provided in this session and related ones. The focus will shift again next year to new data services, with the finalization of several projects, in particular related to the Moon, Mercury, and exoplanets. A workflow platform will also be connected to perform run-on-demand (the OPUS system also used by the ESCAPE H2020 programme) and cloud-based activity will expand.

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[1] Erard et al 2018, *Planet. Space Sci.* **150**, 65-85. 10.1016/j.pss.2017.05.013. ArXiv 1705.09727

[2] Erard et al. 2020, *Data Science Journal* **19**, 22. doi: 10.5334/dsj-2020-022.

[3] <https://ivoa.net/documents/EPNTAP/20201027/index.html> (still open for comments)

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