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A decade of geoinformation sharing at ETH Zurich

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1. Background Information about the Spatial Data Infrastructure at ETH Zurich

ETH Zurich receives proprietary geodata from the Swiss Federal Office of Topography (swisstopo) on the basis of an annual, renewable contract. The organization of the received geodata is file-based, usually in folders named with the year and the quarter of delivery.

A file-based delivery system is not optimal for geodata sharing and the complexity of accessing geospatial data can be challenging for the non-geodata specialists, especially for researchers in other fields than geography, geomatics or cartography. Researchers and students are often interested in a specific region and they do not need nor want to download the complete dataset covering the entire Switzerland. Users spend unnecessarily precious time studying metadata in order to identify and select the correct data tile or layer, having also to deal with GIS tasks such as clipping, merging and reprojecting geospatial data.

As consequence, since 2004, the Institute of Cartography and Geoinformation in cooperation with the ETH Library has been building a corporate Spatial Data Infrastructure (SDI) at ETH Zurich, with the goal of providing ETH Zurich employees with direct access to Geoinformation and Geoservices through a user-friendly geoportal.

Figure 1. The GeoVITe portal

The GeoVITe (GEOdata Visualization and Interactive Training Environment) portal allows its users to access geodata through a standard Web browser as shown in *Figure 1*. The user can visually browse the spatial data, select the desired area and download the necessary

data in a straightforward manner. The portal provides a clear visualization of available geodata products, it facilitates the choice of the right data (map product and location), and it hides the complexities related to merging and extracting the needed data extent.

2. Architectural Components of the GeoVITe SDI

The SDI technical implementation used for GeoVITe is entirely service-driven. We use a three-tier-architecture, with a clear separation between presentation, services and data. The user has access only to a "thin" Web-based interface, which handles the majority of user interactions by sending requests and listening to responses from visualization and geoprocessing services. The services access the corresponding data in the database, do the necessary processing and send the responses back to the user interface. From a software engineering viewpoint, these background services are entirely transparent for the users: they only see that the interface reacts to their commands such as navigating through the different products available, zooming or panning the map, selecting the right area for download, and enabling them to straightforwardly download the desired data (Iosifescu et al, 2011; 2013).

As mentioned before, the corporate SDI at ETH Zurich has been in development since 2004 and the GeoVITe portal has been actively used for the download of geodata since 2010. Currently at version five, GeoVITe portal has experienced a long history of implementation technologies, migrating from proprietary technologies to open software and standards. The first prototype version, finished in 2008, was mainly based on proprietary technologies such as IBM's DB2 (database), ESRI ArcSDE (database middleware) and ESRI ArcIMS (services). The subsequent four versions, from 2009 to 2012, continued to be mainly powered by proprietary software. However, the fifth version, operating since 2013, harmoniously blends open source and proprietary technologies as shown in *Figure 2*.

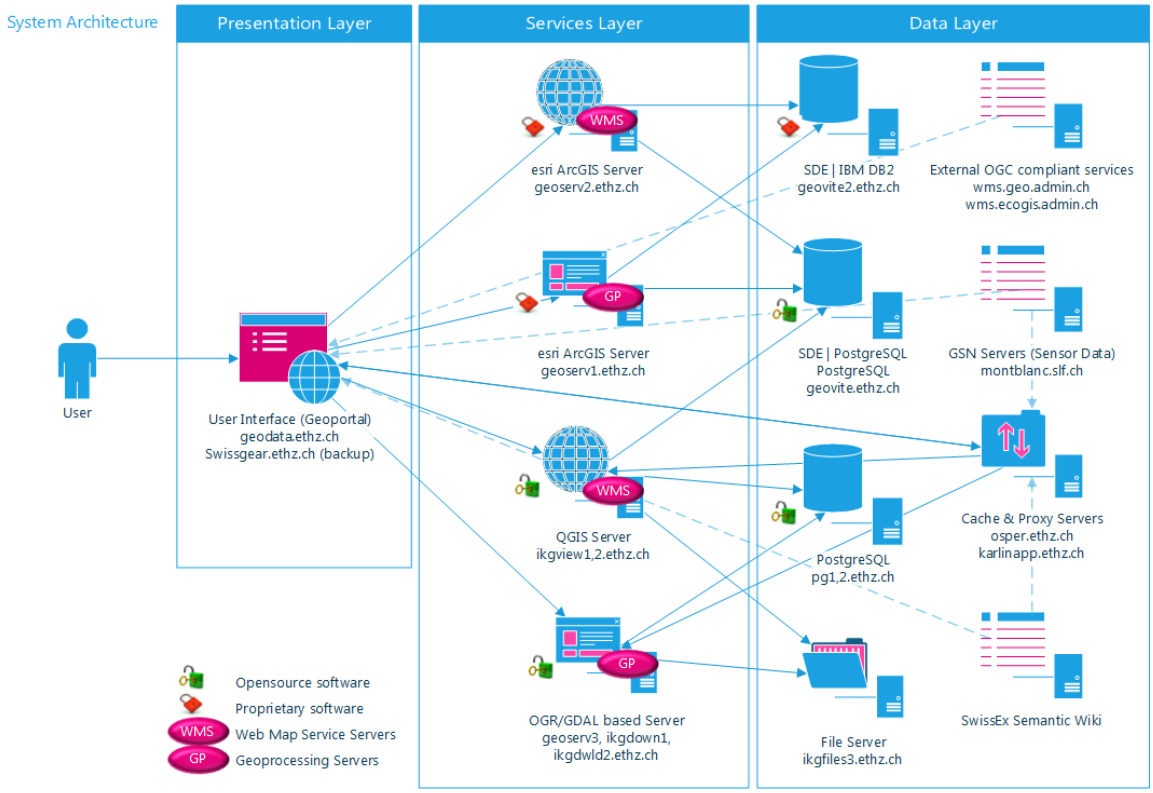

Figure 2. The three-tier architecture of the GeoVITe platform (Iosifescu et al., 2014)

The proprietary technologies used in GeoVITe have been gradually enriched by powerful open source geospatial software such as PostgreSQL/PostGIS (for the fundamental data management) or QGIS Server and GDAL/OGR (for visualization and geoprocessing services). The functional equivalence between the open source and proprietary software is enhanced by the use of established open standards from OGC and W3C (such as WMS, WFS, GML, SVG, etc.), which ensure the long-term interoperability between the different components and technologies. In this context, it is exactly the interplay between open software and open standards that allows us to interconnect various geospatial information management systems into a centralized, usable SDI. This is especially important, since in the recent project Geodata4SwissEDU (funded by swissuniversities.ch), GeoVITe is in the process of expanding to all public universities and research organizations in Switzerland, thus merging the SDI of ETH Zurich with the existing corporate SDIs of all other participating organizations.

3. Motivators, Benefits and Challenges Concerning Integration of Open Source Software in GeoVITe

There are several main motivations for bringing open source software harmoniously along-side proprietary software in GeoVITe. The first one was triggered by the fact that in 2011-2012 the majority of the open source software packages for the geospatial domain have reached maturity. Not only the software themselves (e.g. PostGIS, QGIS, GDAL/OGR) have become stable, mature and trustworthy, but also the entire open source ecosystem reached a critical tipping point. Professional support is currently available from a myriad of private companies, the bug-fixing turnover is considerably faster than in proprietary software and there is now a certainty that many open source projects are here to stay.

The second motivation stems from the flexibility offered by open-source software for implementing research requirements in software, which is valuable from an academic perspective. Because of its open source nature, the source code can be easily extended and adapted to novel research requirements.

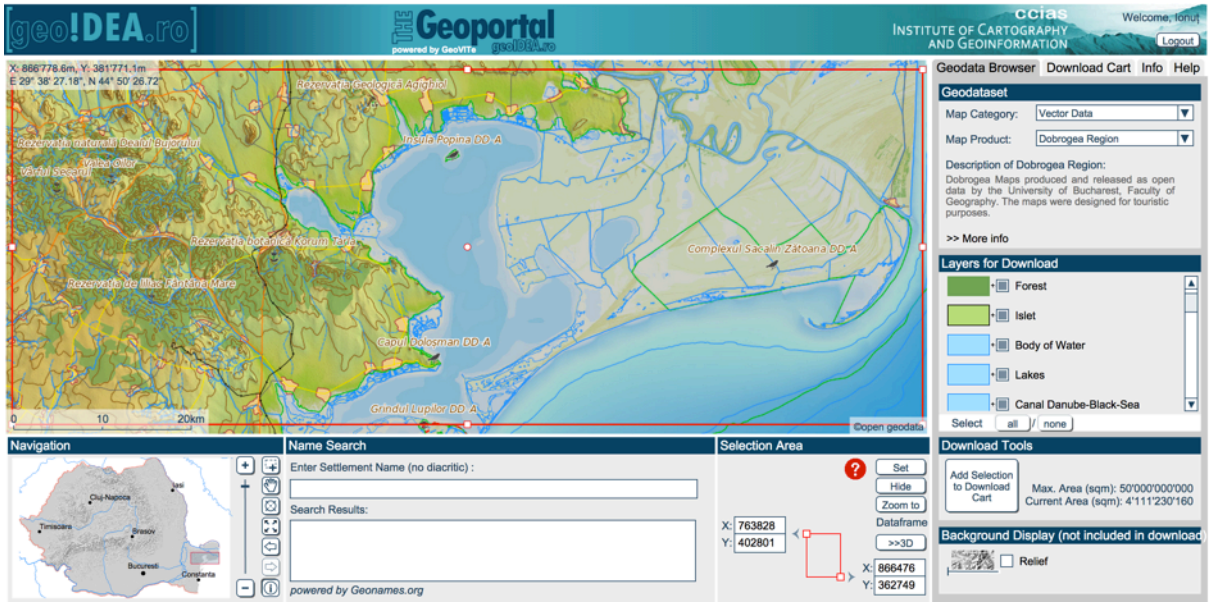

Figure 3. The GEOIDEA.RO geoportal (powered by GeoVITe)

The third motivation is the interest in high-quality open source software that lowers the costs of geodata publication in related SDIs, such as GEOIDEA.RO (shown in *Figure 3*) geoportal. The main objective of the project GEOIDEA.RO (GEodata Openness Initiative for Development and Economic Advancement in ROmania) is to improve the scientific basis for the adoption of an open geodata model in Romania.

In the main GeoVITe framework, we aim to offer both proprietary and open source technologies an equal footing. However, according to the requirements of various related projects, we can quickly switch the underlying portal technologies from proprietary to open-source and vice-versa, especially due to the high interoperability of free and open source software. Therefore, the main benefit of integrating open source software into GeoVITe is the vendor-independence and the flexibility to adapt quickly to a fast-changing geospatial environment. Furthermore, the concept of openness has a serendipitous influence on several other activities, especially when taking into consideration the main duty of academia, namely to propagate knowledge. For example, we support the user-friendly dissemination of existing open geospatial datasets for which redistribution inside our organisation is permitted and we strive to establish new cooperation channels related to geospatial open source technologies with the establishment of an ICA-OSGeo-ISPRS Open Source Geospatial Laboratory at ETH Zurich.

Finally, we have to mention that although there are no barriers concerning the integration of open source technologies in GeoVITe, there is still a major challenge related to the sustainable use of open source technologies in this project. Unfortunately, in-depth open source know-how is still restricted to a minority of people from the ICA-OSGeo Open Source Geospatial Laboratory at ETH Zurich. While users of proprietary software can be easily sent to training courses, achieving an equally comprehensive understanding of open source technologies is not easy. There does not exist an all-encompassing “open source” training. The training courses that do exist are restricted to specific aspects of individual software packages, whereas one needs a solid comprehension in many aspects of the underlying open source software libraries. For example, before understanding and using the spatial extension PostGIS with various GIS software such as QGIS, a user should know first about managing and administering the geospatial database PostgreSQL, to have some IT background, a good knowledge of SQL, an understanding of spatial analysis and a general GIS know-how. Furthermore, a user should be aware of the many underlying libraries used in various open source GIS desktop and server software (such as GDAL/OGR) in order to correctly identify and fix problems that may arise. Therefore, a priority will be to extend the ICA-OSGeo-ISPRS Open Source Geospatial Laboratory at ETH Zurich as a hub for the transfer of knowledge and as well as a support group for the continuing development and use of open source software in GeoVITe.

4. Conclusion

Over the last decade the GeoVITe platform evolved through many technological changes. The most important change occurred in the latest version, when open source technologies were being introduced on an equal footing with proprietary software. As a result, PostgreSQL/PostGIS, GDAL/OGR, QGIS Server and QGIS have become important elements of the open source part of GeoVITe, which harmoniously coexist with proprietary software such as ESRI ArcGIS Server.

The open source technologies in the geospatial domain reached the tipping-point towards functional equivalence with proprietary software, and they represent a mature solution for the implementation of spatial data infrastructure and geoportals. Unfortunately, there is still an absence of good training possibilities for open source software and a solid understanding of open source technologies can only be gradually achieved with a lot of effort invested in apparently different, but interconnected directions. Furthermore, a correct use and development of open source software is driven by an individual's passion, which no training can provide.

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