

FROM DISCOVERY TO DOWNLOAD – THE EOWEB[®] GEOPORTAL (EGP)

Henry Rotzoll, Daniele Dietrich, Klaus Dengler, Bernhard Buckl, Stephan Kiemle, Torsten Heinen

DLR-DFD Deutsches Zentrum für Luft- und Raumfahrt/ Deutsches Fernerkundungsdatenzentrum,
Muenchner Str. 20, 82234 Wessling, Germany

Abstract

The EOWEB[®] GeoPortal (EGP) is the new DLR multi-mission web portal for interactive access to long-term archived Earth Observation (EO) data. EGP implements two innovative approaches. First, it seamlessly integrates the classic catalogue-and-order functions of the current EOWEB[®]-NG portal with new browse-and-download features. Thus, the whole process from “Discovery” to “Download” is combined in one single tool. Furthermore, EGP offers an interactive, responsive, user friendly and appealing state-of-the-art user interface similar to a desktop application. Secondly, it uses common interoperability standards of the Open Geospatial Consortium (OGC) and ESA’s Heterogeneous Mission Accessibility (HMA) initiative. These standards enable EGP to communicate and integrate with the heterogeneous data sources of the German Satellite Data Archive (D-SDA), as well as external data sources. Finally, the core functionality of EGP is separated into detached components, which are further subdivided into three different tiers. This entails that new functionality can be easily added and EGP is customizable for the use of new satellite missions or projects.

Keywords: EOC, Earth Observation, EOWEB, EGP, GeoPortal, Geoservice, D-SDA, OGC, HMA

INTRODUCTION

The rising interest of users from different disciplines in accessing Earth Observation (EO) data and products results in the need to offer fast, easy-to-use, and reliable data access. Interactive, responsive, user friendly and appealing state-of-the-art web portals help users to search, view and retrieve geospatial data, thus promoting the EO data in a wide-range application community. DLR’s Earth Observation Center (EOC) has a long tradition of providing web-based access to EO data, starting 15 years ago with the Earth Observation on the Web (EOWEB[®]) portal, followed by the EOWEB[®]-Next Generation (NG) user interface. In 2015, the existing EOWEB[®]-NG portal will be replaced with a completely new developed user interface that utilizes up-to-date technologies in order to provide better user experiences.

EOWEB[®], the EOC’s multi-mission user services component for EO data, is not only composed of a web-based user interface. It also consists of components providing machine-to-machine interfaces, the EOWEB[®] server and user management. The EOWEB[®] GeoPortal (EGP), presented in this paper, is the new EOC multi-mission web portal for interactive access to long-term archived Earth Observation data. It seamlessly integrates the classic catalogue-and-order functions of the current EOWEB[®]-NG portal with new browse-and-download features for online visualization and access to Earth Observation data. Thus, the complete user scenario from “Discovery” to “Download” is combined in one single tool. This responds to three important trends:

1. The EO data user community is continuously growing, coming with an increasing diversity of user experience levels. Novice users require simple discovery functions and guidance, whereas expert users expect direct data access functions.
2. Increasing amounts of EO data are being held online, allowing inline visualization and direct download access.

- The amount and diversity of EO data being preserved for the long-term in data centers is progressing at petabyte scale. Long time series as well as rarely used historic data sets still require classic catalogue, browse and ordering functions.

In summary, it is an important requirement for DLR's Earth Observation Center (EOC) to be able to offer interactive multi-mission user services for the full stock of EO data via one single web portal.

The latest released version of EGP can be accessed via the URL <https://geoservice.dlr.de/egp>.

Figure 1 shows the start page of the EOWEB[®] GeoPortal (EGP) with the listing of available data.

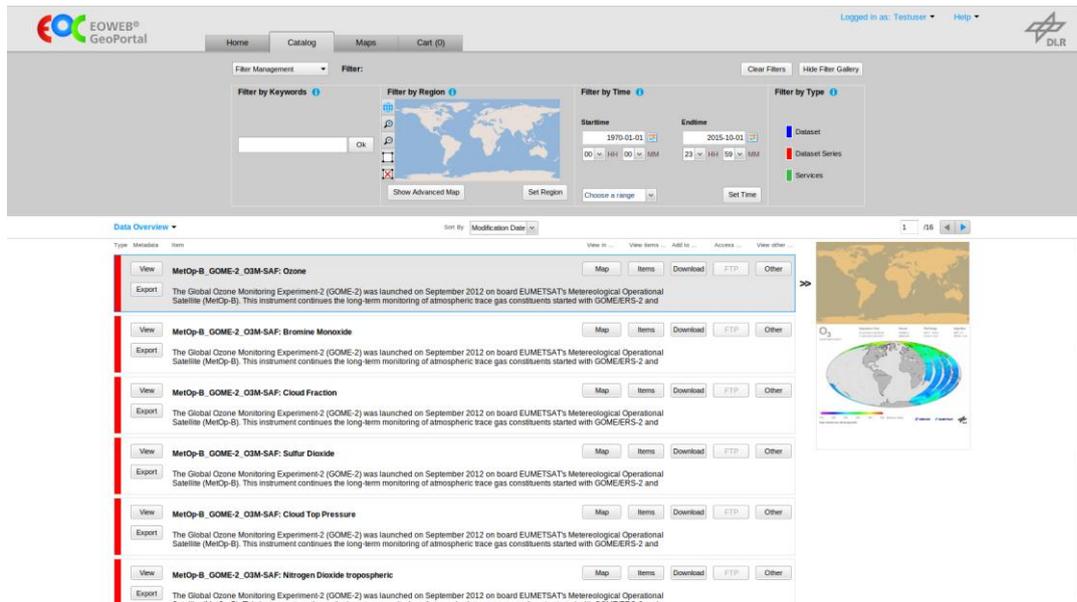


Figure 1: Screenshot of the start page of the EOWEB[®] GeoPortal (EGP)

This paper gives an overview of EGP's context, usability, architecture and the integration of standards.

CONTEXT

The German Satellite Data Archive (D-SDA) at EOC maintains a large archive of Earth Observation (EO) data supplied by national, European and international EO missions [9]. The current data volume exceeds 5 petabytes, increasing by roughly one petabyte a year. A major task of D-SDA is long-term data preservation (LTDP). By following international LTDP guidelines, the valuable and unique data, including extended time series, are safeguarded against loss and kept accessible and useable for future generations. Providing user-friendly and interoperable access to the archived data sets becomes more and more important within LTDP. To enable interdisciplinary use of EO in combination with other spatial data, interoperability and harmonization of data formats and access protocols is a major challenge.

Figure 2 shows the two different paths of spatial data access to the D-SDA:

- The Earth Observation Center (EOC) Geoservice [3] has been established to provide interoperable access to higher level data, that is further processed, combined and aggregated to layer-based data (data processing levels 2 and more) as needed by the geodata community. It contains both, selected German Satellite Data Archive (D-SDA) data sets and data sets provided by external providers such as application projects which value-added data is not necessarily archived within D-SDA.
- The Earth Observation on the Web (EOWEB[®]) is the user service system of DLR's multi-mission payload ground segment composed of distributed services which allow reception, processing, archiving, ordering and delivering of data products. It provides a traditional, order-based access system for users of the EO Community [8, 10]. The Long Term Archive (LTA) Product Library (PL) [11] serves as the main data source. The LTA PL triggers the Product Upload Service whenever new data is available. Corresponding metadata is then uploaded to

EOWEB[®]. Data in D-SDA is often scene-based (EO Products) and not aggregated as needed by the Earth Observation community.

The EOWEB[®] GeoPortal (EGP) will become the main portal for accessing D-SDA data. It will incorporate both data access methods using the following interfaces:

- The EOC Geoservice provides interoperable and direct data access through spatial data services compliant with standards established by the Open Geospatial Consortium (OGC) [13].
- Through OGC-compliant data interfaces developed in the Heterogeneous Mission Accessibility (HMA) initiative [5] the users can search for and order EO data and products in EOWEB[®].

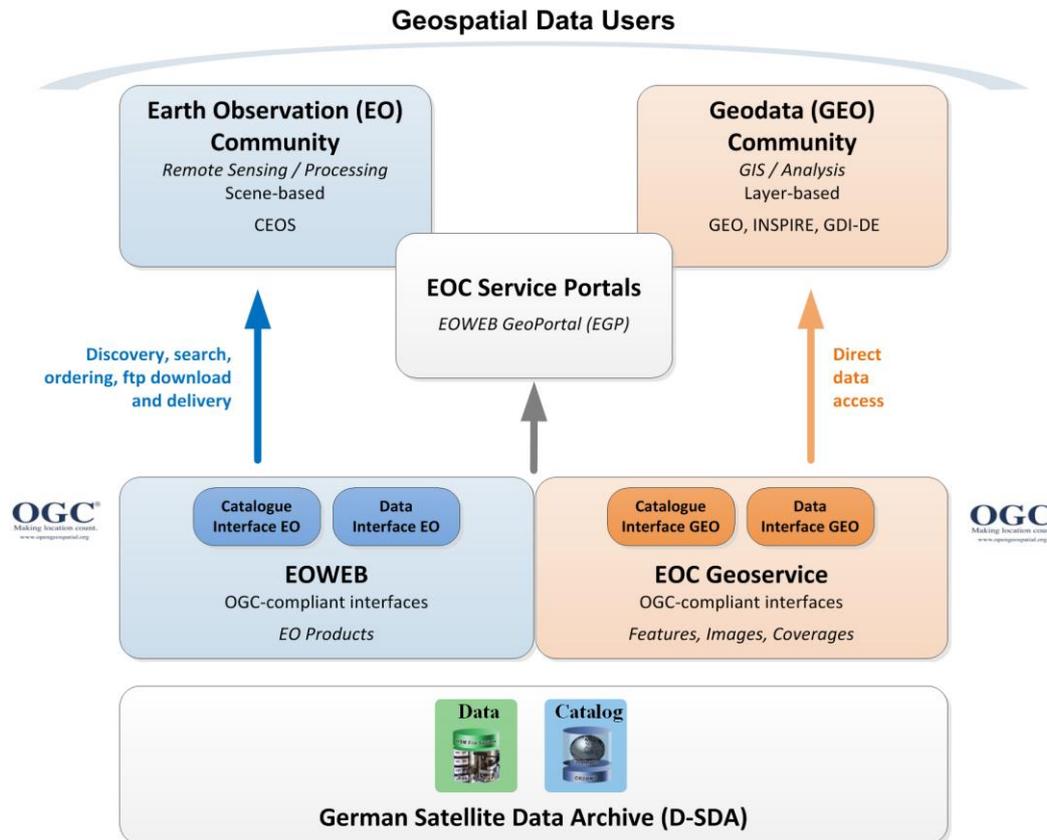


Figure 2: Access to the German Satellite Data Archive (D-SDA) through OGC compliant interfaces & services.

As figure 2 also shows, in addition to EGP, users can access the data in EOWEB and the EOC Geoservice directly through the standardized interfaces.

USABILITY AND USED TECHNOLOGIES

The EOWEB[®] GeoPortal (EGP) was designed to let the user “discover” all the available data from the very heterogeneous data sources of EOWEB and the EOC Geoservice (see context section above) in one combined view. Thus, as an entry point, the catalogue of all available data sets, data set series and services independent of the source are presented to the user (see figure 1). This list can be further narrowed down by keywords, region, time and type (see figure 1, upper part). After choosing a data set, the user can, depending on the type of data, order it, download it directly (via FTP or the Web Coverage Service (WCS)), show the containing parts (items), visualize it on the map or look at the metadata directly from the catalogue.

Nevertheless, the classic catalogue-and-order function of the old EOWEB[®]-Next Generation (NG) user interface can be still used, as it is possible to directly select a data collection and view all scenes in a list. Figure 3 shows a screenshot of this feature:

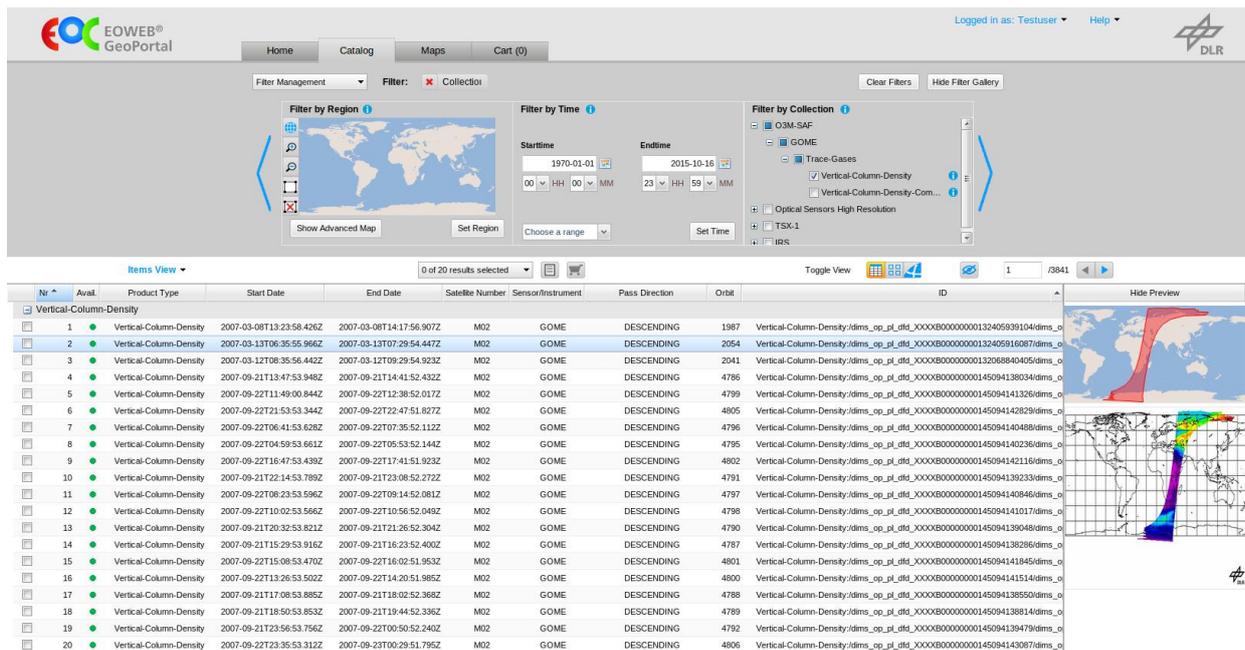


Figure 3: Screenshot of the classic catalogue-and-order function view in the EOWEB® GeoPortal (EGP)

As a summary, EGP provides the following main functions:

- Searching and inspection of metadata descriptions from the EOC Catalogue
- Generation of individual maps by adding, removing and altering data layers
- Visualization of layers providing temporal information for certain points in time
- Download of data subsets and whole layers
- Searching and inspection of EOWEB catalogue products
- Specification and submission of EOWEB catalogue product orders
- Monitoring of the order processing status

The EOWEB® GeoPortal (EGP) is designed to offer an interactive single-page user interface on the web, similar to a desktop application. To reach this goal, the front end is built with the Java-to-JavaScript Framework Google Web Toolkit (GWT) [7], and SmartGWT [14] is used as a widget library. Because of this single-page approach, the navigation within the page (e.g. select a different tab) is done by HTML anchors. These internal links are also stored in the browser history and can therefore be accessed via the browser's forward and back button.

The GWT cross-compiler translates the Java application to standalone JavaScript files that are optionally obfuscated and deeply optimized in terms of size and browser compatibility. Thus, GWT-generated JavaScript is smaller in size and has a better performance than hand-written JavaScript. Additionally, with new versions of the compiler, existing code can be further optimized without changing it.

On the server side, EGP benefits from Spring [15] as the primary Java framework for dependency injection, security and design pattern implementation.

EGP supports the following browsers: Internet Explorer, Firefox, Chrome and Safari. It needs a minimum screen resolution of 1024x768 pixels. Mobile devices are currently not supported.

OVERVIEW OF THE ARCHITECTURE OF EGP

EGP is horizontally divided by three different layers (also called tiers):

- The *user interface layer* contains the HTML and JavaScript running in the user browser

- The *service layer* handles the tasks that have to be performed on the server side of the web application. These are session, configuration and content resources management. It also provides the connection between the user interface and the communication layer.
- The *communication layer* handles the connections, requests and responses to and from the underlying backend services.

For the exchange of data between the layers a *domain model* is used. It contains Plain Old Java Objects (POJOs), which are simple Java classes with fields and their respective getters and setters, but no application logic.

Figure 4 shows an overview of the horizontal structure of EGP and the backend services. The usage of standards to connect the underlying back end services are explained in the next chapter.

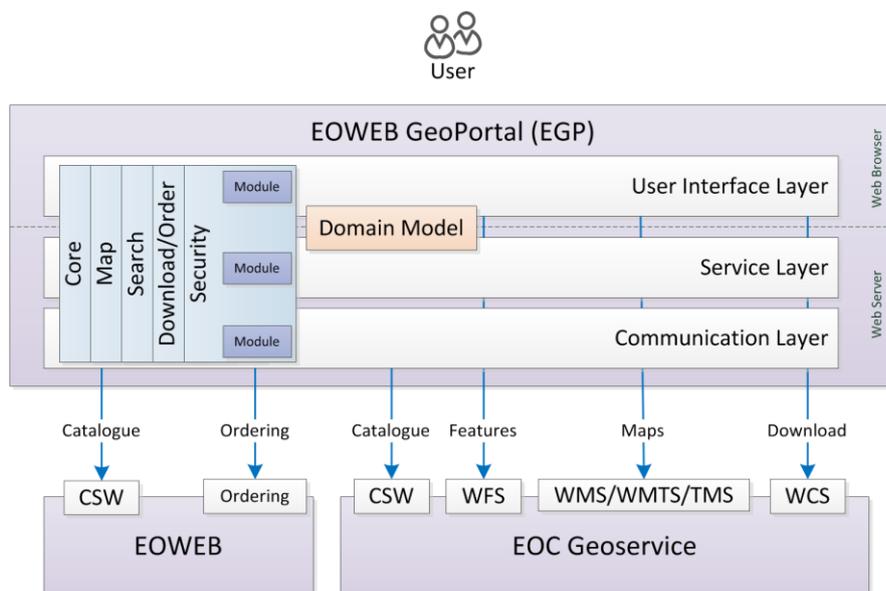


Figure 4: Basic Architecture of the EOWEB[®] GeoPortal (EGP)

EGP is further vertically divided by so-called *components* (see figure 4). Components are functional units responsible for dedicated tasks. They can span all three layers (see above). The following table 1 gives an overview of the EGP components:

Component	Description
Core	General functions used by other EGP components
Map	Map view generation, feature search and retrieval
Search	Catalogue search and retrieval
Download/Order	Download, order specification, submission and follow up
Security	User Authentication, Authorization and Registration

Table 1: EOWEB[®] GeoPortal (EGP) components and their tasks

Each part of a component in one of the three layers is a so-called *module* (see figure 4). Modules are independent units and can be individually used in other modules or applications.

In the user interface layer, the *Model View Presenter (MVP)* [6] design pattern was used to keep the view technology separated from the application logic through well-defined interfaces. This has several advantages:

- the application is more independent from the view technology used
- the testability of the application logic code is increased
- the maintainability and expandability of the application is improved

Four main parts of the MVP pattern are illustrated in the structural diagram of figure 5:

- The *model* is an interface defining the data to be displayed or otherwise acted upon in the *view*. The model is only updated and retrieved by the presenter.

- The *view* is a passive interface that displays data (the model) and routes user commands (events) to the presenter to act upon that data. It does not have access to the model and the presenter. All control of the view is done by the presenter
- The *presenter* is the connection between the model and the view. It retrieves data from the repositories (the model), and formats it for the display in the view. For every presenter there is exactly one view. The presenter contains all the application logic and should be extensively tested. The view can be replaced by a mock or a stub for the tests.
- The *AppController* acts as a supervising presenter. It chooses the correct presenter, depending on the state of the application, as all the different presenters of the application are only connected by the model and an event bus.

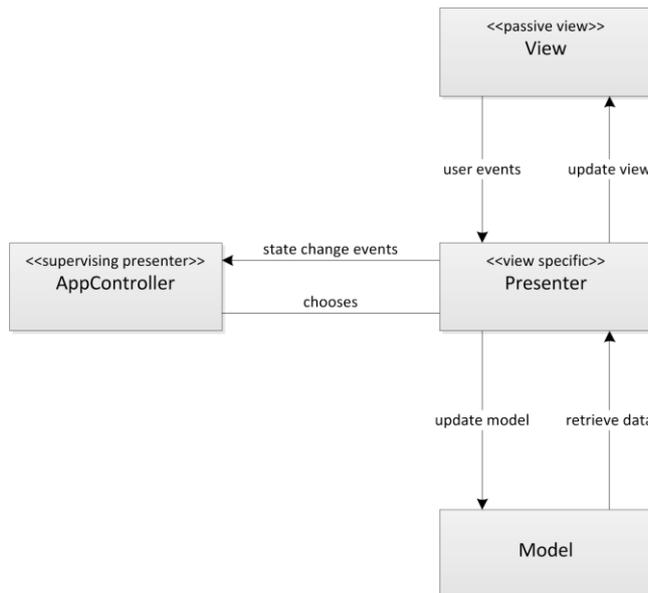


Figure 5: Schema of the Model View Presenter (MVP) Pattern used in the User Interface Layer of EGP

Another concept of EGP is the so-called *provider* modules. They are part of the communication layer and handle the exchange with the underlying backend data services (see figure 4). Furthermore, they encapsulate the data service specifics. Between the EGP service modules and the provider modules request and response objects are exchanged, which are defined in the domain model. The tasks of the provider module are:

- to translate the requests into the data service specific requests
- to submit the requests
- to retrieve the responses
- to translate the response back into an EGP response object

Service and provider modules are strictly separated from each other. Communication between them is only possible via the Service Provider Interface (SPI). Therefore, new providers can be exchanged, altered, or added without changing the service layer.

Expandability and customizability was emphasized early in the design phase of EGP. Thus, different instances of EGP, running independently, can be tailored for various missions and projects. This can be achieved in three different ways, depending on the degree of customization:

- by using the same EGP software, but a different set of property files and resources
- by using the Maven WAR overlay [1, 12], for creating different brandings of the application and altering some of the application logic and visualization code
- by creating a completely new web project and using parts of the EGP module libraries for the application logic and views

An example of the third customization option is the Earth Observation Image Librarian (EOLib) project [4], where EGP was used, extended and tailored as the front end to access the data.

INTEGRATION OF STANDARDS

The EOWEB® GeoPortal (EGP) uses a range of common interoperability standards of the Open Geospatial Consortium (OGC) [13] in its communication layer (see architecture section), to underlying services:

- the Catalogue Service Web (CSW) for data discovery
- the Web Feature Service (WFS) for vector data viewing and attribute data retrieval
- Web Map Service (WMS) including WMS Time (WMS-T), Tile Map Service (TMS) and Web Map Tile Service (WMTS) for raster and vector data viewing
- the Web Coverage Service (WCS) for data download

In addition, the EOWEB Heterogeneous Mission Accessibility (HMA) [5] services are supported via the HMA CSW and HMA Ordering standards. HMA standards have been developed by the European Space Agency (ESA) in cooperation with other Earth Observation data providers and the OGC. EOPS (the EOWEB Ordering and Programming Service) implements the HMA “Ordering Services for Earth Observation Products”. It provides, among others, interfaces for order options retrieval, order submission, order status monitoring and online delivery to pick-up points for archived Earth Observation products that are not available for online access via WCS. The order options allow user client applications to tailor the products to be ordered and provide limited subsetting capabilities. After submission user clients can monitor the processing progress of the ordered products which are finally delivered to a pickup point. The DLR implementation of the ordering interfaces connects with the EOWEB® server, see figure 4. Users are authenticated via SAML assertions, thereby implementing another HMA standard: “User Management Interfaces for Earth Observation Services”. A user’s restrictions regarding which products are orderable and which order options are available depend on the EOWEB® server’s access policy.

The EOWEB Catalogue on the WEB (ECSW) standard is used for the catalogue metadata definition.

The user authentication, authorization and registration in EGP are done by the EOC User Management Service (UMS) with the Central Authentication Service (CAS) [2] protocol from the security component.

As a summary, these standards enable EGP to sustainably communicate with the OGC interfaces of the EOC Geoservice and EOWEB®, as well as external OGC-compliant services (see context section). This allows the end user to individually visualize EO data products with additional geodata from any source on the same web platform.

The following figure 6 shows an overview of the usage of the interoperability standards between the different EGP components (see architecture section) and the underlying backend services:

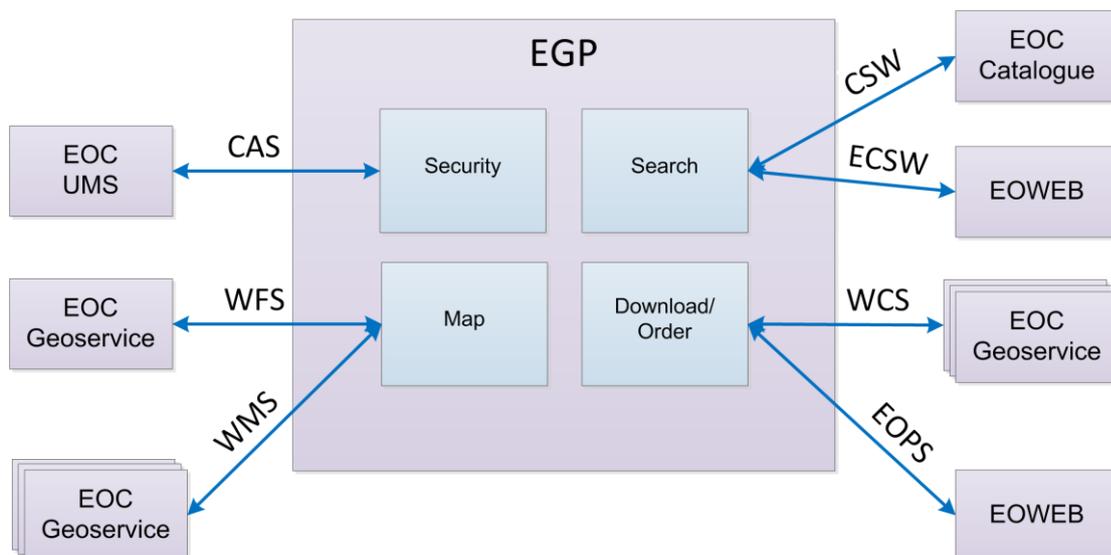


Figure 6: Components of the EOWEB® GeoPortal (EGP) and their communication standards to backend services

CONCLUSION AND OUTLOOK

The Earth Observation data holdings of the German Satellite Data Archive (D-SDA) are accessible to the EO Community through the new EOWEB[®] GeoPortal (EGP), which will supersede the old EOWEB[®]-NG data portal and use common interoperability standards.

With the release of the EOWEB[®] GeoPortal (EGP) development will continue further. User feedback will help to improve the usability. New satellite missions and new projects will require new features to be implemented. For example, EOC is conducting the ESA project “Evolution of EO Online Data Access Services” (EVO-ODAS) which aims at enhancing technologies for EO data access and will probably lead to improved service interfaces to which EGP will be adapted.

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