GEodata Openness Initiative for Development and Economic Advancement in Romania

Joint Research Project under the Romanian-Swiss Research Programme

Project Number: IZERZ0-142129

PROGRAMUL DE COOPERARE ELVEȚIANO-ROMÂN
SWISS-ROMANIAN COOPERATION PROGRAMME

Implemented web services

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Issue / Revision: 1 / 0

Date: 15.12.2014

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GEOIDEA.RO Report

GRANT AGREEMENT NR:	SUBJECT:	PROJECT COORDINATOR:
IZERZ0-142129	Implemented web services	ETH Zurich
ISSUE / REVISION: 1 / 0	**INTERNAL REFERENCE :** geoidea_deliverable_15	

ABSTRACT:

This report documents the web services that are implemented for the geoportal of the GEOIDEA.RO project. It explains their role and functionality within the geoportal workflow. It details the web map services (WMS), web feature service (WFS), and other web services implemented. This includes the exact links to the GetCapabilites of the WMS used by the geoportal to display the geospatial data, as well as examples for the GetMap and GetFeatureInfo of the WMS and the GetCapabilities of the WFS. Additionally, the custom web service used for clipping and extracting the data requested by the user is explained with concrete request examples.

Project co-financed by a grant from Switzerland through the Swiss Contribution to the enlarged European Union. Responsibility for the content of this report resides in the author or organisation that prepared it.

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1. INTRODUCTION

1.1 *Purpose*

The purpose of this report is to document the different web services implemented for or used by the GEOIDEA.RO geoportal. It aims at describing their general functionality and how they integrate in the geoportal workflow and architecture. Furthermore, the report covers the standards that are used in the chosen implementation.

1.2 *Abbreviations*

GDAL/OGR Geospatial Data Abstraction Library (cross platform C++ translator library for raster and vector geospatial data formats)

GUI Graphic User Interface

HTTP HyperText Transfer Protocol

JPG or JPEG, lossy compression for digital images

OGC Open Geospatial Consortium

PNG Portable Network Graphic

XML Extensible Markup Language

WFS Web Feature Service

WMS Web Map Service

WPS Web Processing Service

2. IMPLEMENTED WEB SERVICES

Web services allow providing the geoportal user with functionality that run on distant servers and not on their computer. They fulfil task ranging from processing data to delivering them to the user. To improve the interoperability of the different services, we use a standard specifications when they exist for the implementation of the web services.

2.1 *Web Map Service (WMS)*

The Web Map Service (WMS) is an international standard developed by the Open Geospatial Consortium (OGC) and widely used in web cartography because it allows providing the users with spatially referenced maps very easily. The standard more specifically defines the "behaviour of a service that produces spatially referenced maps dynamically from geographic information" (OGC 2006). The standard stipulates the required operations that should be implemented in a web map server. These include the ability to retrieve a description about the layers of spatial information offered by the server, to retrieve the information in the form of a map image and to query the server about the object displayed on the map. This standard does not let the users retrieve actual feature or coverage data values; it only renders the data in a graphical format (mostly PNG and JPG).

The WMS standard is used to render the spatial data and deliver the output maps to the graphic user interface (GUI) of the geoportal. It supports a wide range of coordinate reference systems as well as the three requests defined in the standard (GetCapabilities, GetMap, GetFeatureInfo) for all the layers mentioned in Annex A.

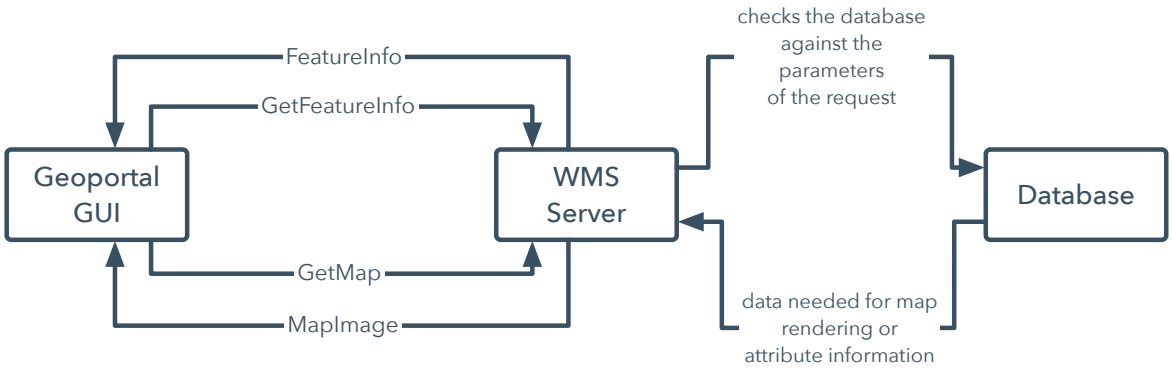

Figure 1. Web Map Service integration to the geoportal.

The geoportal acts as the client and displays the maps (through a GetMap request) or information about a feature (through a GetFeatureInfo request) requested by the user through the GUI, thus the user does not have deal with the requests themselves. However, the web map services implemented

for the project are also available through an HTTP request. Table 1 lists all the WMS available on the geoportal as of 30.11.2014 with their GetCapabilities request. The WMS version 1.1.1 and version 1.3.0 are supported by this QGIS server 2.2 implementation.

Table 1. List of implemented WMS and their GetCapabilies request links

Map Category	*Map Product*	*GetCapabilities Link*
Raster Maps	Dobrogea Maps	http://geocarto.ethz.ch/cgi-bin/dob_raster_maps/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Hydrogeological Map	http://geocarto.ethz.ch/cgi-bin/ro_bgr_hydrogeo/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
Raster Data	Landsat	http://geocarto.ethz.ch/cgi-bin/ro_raster_data/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Elevation Model	
	Relief	
Vector Data	Open Street Map Vector 3	http://geocarto.ethz.ch/cgi-bin/osm/qgis_mapserv.fcgi?map=ro_osm_20141118.qgs&SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Protected Areas	http://geocarto.ethz.ch/cgi-bin/ro_natura/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Groundwater Horizons	http://geocarto.ethz.ch/cgi-bin/ro_eea_groundwater/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Political Colours for Romania	http://geocarto.ethz.ch/cgi-bin/ro_politicalcolours/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Statistics for Localities	http://geocarto.ethz.ch/cgi-bin/ro_despresate/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	CLC Urban Atlas	http://geocarto.ethz.ch/cgi-bin/ro_clc_urban/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Dobrogea Region	http://geocarto.ethz.ch/cgi-bin/dob_vector/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Bucegi Natural Park	http://geocarto.ethz.ch/cgi-bin/bnp_bucegi/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Hydrogeology (Sample)	http://geocarto.ethz.ch/cgi-bin/ferrah_hydrogeo/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Danube Fairway	http://geocarto.ethz.ch/cgi-bin/dan_afdj_fairway/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Livestock	http://geocarto.ethz.ch/cgi-bin/gov_animals/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
Data.Gov.ro	Sanitary Expenses	http://geocarto.ethz.ch/cgi-bin/gov_sanitary_expenses/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Health Personnel	http://geocarto.ethz.ch/cgi-bin/gov_health_personnel/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities

	Health Infrastructure	http://geocarto.ethz.ch/cgi-bin/gov_health_resources/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Demography Information	http://geocarto.ethz.ch/cgi-bin/gov_demography/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Prisons	http://geocarto.ethz.ch/cgi-bin/gov_prisons/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Sanitary Network	http://geocarto.ethz.ch/cgi-bin/gov_sanitary_network/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Driver Licenses	http://geocarto.ethz.ch/cgi-bin/gov_auto_permits/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities
	Goods Transportation Licenses	http://geocarto.ethz.ch/cgi-bin/gov_transpo_licenses/qgis_mapserv.fcgi?SERVICE=WMS&VERSION=1.1.1&REQUEST=GetCapabilities

Example of a GetMap request

http://geocarto.ethz.ch/cgi-bin/ro_eea_groundwater/qgis_mapserv.cgi?map=ro_eea_groundwater.qgs&REQUEST=GetMap&SERVICE=WMS&VERSION=1.1.1&CRS=EPSG:31700&WIDTH=1035&HEIGHT=795&FORMAT=image/png&BBOX=149745.984375,224921.4375,863463.7579599055,773139.4375&TRANSPARENT=true&LAYERS=ro_eea_groundwater&STYLES=default

The GetMap request returns an image file containing the rendering of the data in the form of a map. This image is display in the GUI of the geoportal.

Example of a GetFeatureInfo request

http://geocarto.ethz.ch/cgi-bin/bnp_bucegi/qgis_mapserv.cgi?map=bnp_bucegi.qgs&LAYERS=bnp_geology200k_geology&SERVICE=WMS&VERSION=1.1.1&REQUEST=GetFeatureInfo&CRS=EPSG:31700&BBOX=515651.14730878186,412778,553418.8526912181,445778&WIDTH=404&HEIGHT=353&QUERY_LAYERS=bnp_geology200k_geology&INFO_FORMAT=text/xml&X=220&Y=150

The GetFeatureInfo request is used to query information about the features on the map (attributes). The user can enable the Info button and by clicking on the map, the user will launch a function sending the request to the server. The information is returned in a xml document that is parsed and displayed in the GUI.

2.2 *Web Feature Service (WFS)*

The Web Feature Service (WFS) is another international standard belonging to the OGC and it "specifies the behaviour of a service that provides transactions on and access to geographic features

in a manner independent of the underlying data store" (OGC 2005a). This means, to the opposite of the WMS, that the WFS standard allows the user to access and retrieve the spatial data that was used to create the map.

The WFS functionality, as implemented in the logic tier of the geoportal, enables the users to explore and retrieve the data, but not to delete or change them nor to add new ones. All the vector layers available on the geoportal can be retrieved through the WFS protocol (see layers with an asterisk in Annex A). The WFS are implemented using the QGIS server 2.2 and are available through the WFS protocol version 1.0.0 at the same basic URLs that are used for the WMS services listed in Table 1 (by replacing the WMS value by WFS and changing the version number).

2.3 *Web Processing Service (WPS)*

Web Processing Service (WPS) is an OGC standard that "provides client access across a network to pre-programmed calculations and/or computation models that operate on spatially referenced data" (OGC 2005b). WPS have not been implemented for this project due to the overly generic interface offered as well as for performance reasons. Therefore, custom web services for geoprocessing have been implemented instead (see next section).

2.4 *Custom Web Services*

The spatial data requested for download by the user in the geoportal is extracted from the corresponding datasets by custom web services, differentiated for raster and vector data. The implementation is based directly on the GDAL/OGR C++ geospatial library and exposed as a Web service with the JOpera framework, which insures good performance even for large datasets.

The open geoprocessing (opengp) services have an asynchronous API in two stages.

Stage 1

The first stage is a main request (see 1a in Figure 2) that triggers the corresponding web clipping service (clip_vector or clip_raster) by providing parameters such as the x and y coordinates of the upper left and lower right corners of the download area (ulx, uly, lrx, lry), the codename of the desired product (in), the format of the output (format) and a special parameter that signals an asynchronous interaction (Action=Start).

Example of a request for vector datasets:

> http://geodata_processing_server/opengp/rest/clip_toolkit/clip_vector/1.0/?ulx=558000&uly=340000&lrx=620000&lry=309000&in=osm/ro_10_osm_roads&user=geoidea@ethz.ch&format=shp&Action=Start

Example of a request for raster datasets:

http://geodata_processing_server/opengp/rest/clip_toolkit/clip_raster/1.0/?ulx=558000&uly=340000&lrx=620000&lry=309000&in=ro_landsatTM&user=geoidea@ethz.ch&format=tif&Action=Start

The corresponding opengp service replies to the asynchronous request with a message containing the name and number of the processing instance, a confirmation that the geoprocessing job was started and finally, a partial URL containing the job number at the latest position (see 1b in Figure 2).

Example of a response for vector datasets:

clip_toolkit.clip_vector [1.0].1 Started /rest/clip_toolkit/clip_vector/1.0/301/

Example of a response for raster datasets:

clip_toolkit.clip_raster [1.0].9 Started /rest/clip_toolkit/clip_raster/1.0/11/

Stage 2

In the second stage, the client is able to probe the server with an URL that can be constructed from the previous response after a known pattern that takes into account the returned job number (e.g. 301) (see 2a in Figure 2).

Example of a URL used to poll the service:

http://geodata_server_name/opengp/rest/clip_toolkit/clip_vector/1.0/301/0/Output/out

The server can be polled in order to check if the processing is completed. When completed, the response (see 2b in Figure 2) of the server will be the id of the extracted file to be downloaded (e.g. geoidea.ro1c1551b6-a9f1-4a1d-b0f6-0c1ef001596f).

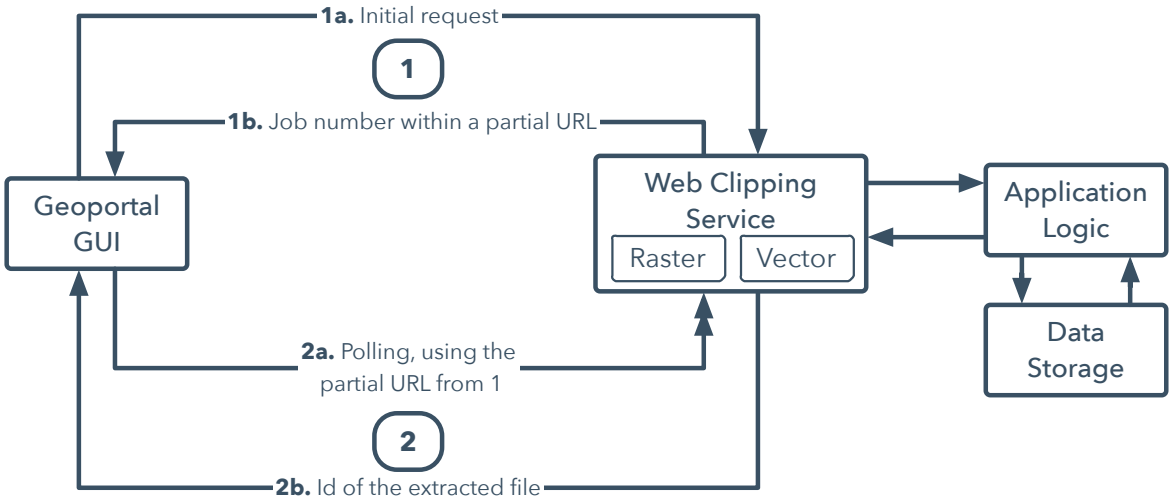

Figure 2. Workflow overview of the custom clipping web service and its integration to the geoportal.

2.5 *GeoNames Web Service*

The GeoNames geographical database contains over eight million place names with categorical attributes and covers the whole world (GeoNames 2014). The database is available for free under a creative common license. Additionally, it offers a web service and this service could be integrated to the GEOIDEA.RO geoportal. It enables the users to search localities based on their name. This web service illustrates the integration of a third party web service within the geoportal. The GUI sends the user request to the GeoNames that sends back possible matches and their geographic coordinates. These coordinates are then projected onto the Romanian reference system and allow the geoportal to zoom in on the place. The geoportal user does not see the details of the request; the GUI of the geoportal handles it.

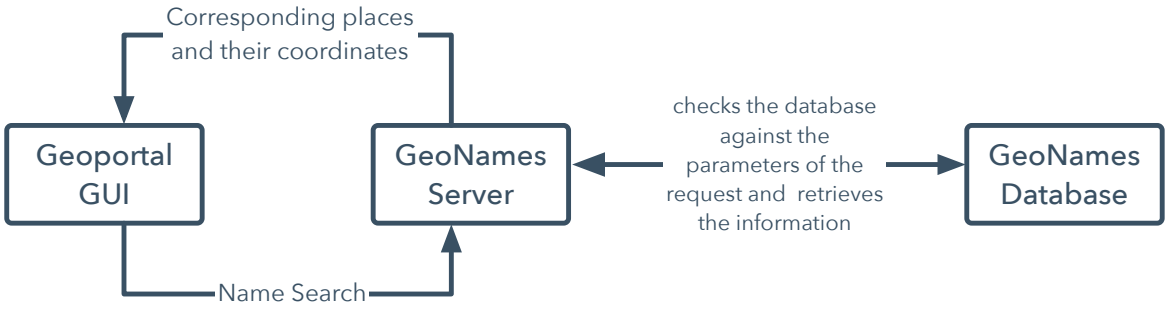

Figure 3. GeoNames web service integration to the geoportal.

3. REFERENCES

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Open Geospatial Consortium (2006). OpenGIS® Web Map Service Implementation Specification. Version 1.3.0. http://www.opengeospatial.org/standards/wms (accessed on 31.10.2014).

Open Geospatial Consortium (2005a). Web Feature Service Implementation Service. Version 1.1.0. http://www.opengeospatial.org/standards/wfs (accessed on 31.10.2014).

Open Geospatial Consortium (2005b). OpenGIS® Web Processing Service. Version 1.0.0. http://www.opengeospatial.org/standards/wps (accessed on 31.10.2014).

4. ANNEXES

Annex A – List of available layers on the geoportal

As of 31.10.2014

Map Category	*Map Product*	*Layers*
Raster Maps	Dobrogea Maps	Dobrogea Map
		Danube Delta Map
	Hydrogeological Map	Map Sheet Budapest
		Map Sheet Bucharest
Raster Data	Landsat	Landsat TM
		Landsat ETM
	Elevation Model	Digital Elevation Model
	Relief	Colored Relief
		Relief
		Relief (cut at the border)
Vector Data	Open Street Map Vector	Landuse*
		Natural*
		Boundaries*
		Waterways*
		Roads*
		Railways*
		Cities (from Natural Earth) *
	Open Street Map Vector2	Landuse*
		Natural*
		Building*
		Waterways*
		Road*s
		Railways*
		Aeroways*
		Aerialways*
		Amenities*
		Highway Point*
		Railway Point*
		Natural Point*
		Cities*
		Water Point*
		Tourism Point*
		Historical Point*
	Open Street Map Vector 3	Landuse*
		Natural*
		Waterways*
		Waterways*
		Buildings*
		Aeroways*
		Highways*
		Railways*
		Aerialways*
		Waterways (pt) *
		Highways (pt) *
		Railways (pt) *
		Historic (pt) *
		Natural (pt) *
		Tourism*

		Places*
		Amenities*
	Protected Areas	Bioregions*
		Parks*
		Reservations*
		SCI (Sites of Community Importance) *
		SPA (Special Protected Areas) *
		SAC (Special Areas of Conservations) *
		The Carpathians*
	Groundwater Horizons	The 4 Horizons*
		Horizon 4*
		Horizon 3*
		Horizon 2*
		Horizon 1*
	Political Colours for Romania	Municipality Mayor 2012*
		County Council President 2012*
		Census Data 2010-2011*
		County (Judet) Boundaries*
		Municipality Boundaries*
	Statistics for Localities	Population 1930-2011*
	CLC Urban Atlas	Admin. Boundary*
		Urban Atlas*
	Dobrogea Region	Colored Relief
		Forest*
		Islet*
		Body of Water*
		Lakes*
		Canal Danube-Black-Sea*
		Settlement*
		Settlement Ukraine*
		Parks*
		Reserves*
		Reserve Names (labels) *
		Altitude Curve*
		Sea Bathymetry*
		Permanent River*
		Temporary River*
		Boundary*
		Coastline*
		Roads*
		Roads Ukraine*
		Railway*
		Lakes (labels) *
		Altitude Point*
		Main Cities (labels) *
		Towns (labels) *
		Point of Interest*
		View Point*
		Lighthouse*
	Bucegi Natural Park	Geology*
		Soils*
		Contours*
		Rivers*
		Lakes*
		Peaks*
	Hydrogeology (Sample)	OSM Natural*
		OSM Highway*
		Geology*
		Study Perimeter*
		Cemetery*

		Superficial Depth*
		Piezometric Level*
	Danube Fairway	Fairway*
Data.Gov.ro	Livestock	Livestock (counties) *
		Livestock (UAT) *
		Livestock (localities) *
	Sanitary Expenses	Drugs expenses per bed*
		Total expenses per bed*
		Drugs expenses per day*
		Total expenses per day*
		Drugs expenses per patient*
		Total expenses per patient*
	Health Personnel	Doctors*
		Family doctors*
		Medical assistants*
		Auxiliary personnel*
		Physiokinetic therapists*
		Physiotherapits*
		Dentists*
		Pharmacists*
		Midwives*
	Health Infrastructure	Nb Creches*
		Nb Creche Beds*
		Nb Hospitals*
		Nb Hopital Beds*
		Nb Pharmacies*
		Nb Polyclinics*
		Nb Territorial Dispensaries*
		Nb Enterprise Dispensaries*
		Endowments with hospital beds*
	Demography Information	Population Age Groups (1970,1980,1990,2000,2010) *
		Life Expectancy (f) (2010) *
		Life Expectancy (m) (2010) *
		Deaths per 1000 births (2010) *
		Nb Deaths in delivery and pregnancy (1970,1980,1990,2000,2010) *
		Nb Live Born (1970,1980,1990,2000,2010) *
		Nb Stillborn (1970,1980,1990,2000,2010) *
		Nb Deaths under 1 year (1970,1980,1990,2000,2010) *
		Natality Rate (2010) *
		New Pregnant Women*
		Female Fertility*
		Fetal Mortality*
		Infant Mortality Rate*
		Mortality Ratios*
		Nb Abortions*
		Abortions for 1000 births*
	Prisons	Prisons*
	Sanitary Network	Admin. Boundaries*
		Sanitary Network*
	Driver Licenses	Driver Licenses*
	Goods Transportation Licenses	Goods Transportation Licenses*

* WFS enabled layers