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The Proposal of Realization the OGC Geospatial Web Services' Symbolization

1. Introduction

The pace of Internet in recent years provide to easy and free access to all kind of information, including geospatial data. These data are mostly used by public administration. However, private persons and institutions are more often interested in viewing and analyzing geodata. It causes necessary of developing an appropriate system.

This system is Spatial Data Infrastructure, which is a set of technologies, political, economic and institutional projects that help in using and accessing to spatial data [2].

The essence of SDI is to initiate the technical arrangements, agreements, norm and laws, which improve access to spatial data and facilitate geoinformation usage at various administrative levels – from local uses, through the national level, to the global range. The SDI can be also understood as standards and rules of the mutual data sharing. The result of it is cost reduction of receiving and updating data and provides consistency of this data in databases [1].

SDI in Europe

The INSPIRE directive was published by the European Parliament on April 25th, 2004. On May 15th, 2007 INSPIRE was ratified. Since then, European Member States had two years to adapt law to implement the directive.

INSPIRE requires from the Member States to build spatial data infrastructure by establishing the services: discovery, view, download and transformation [5].

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Open Geospatial Consortium, Inc ®

The Open Geospatial Consortium, Inc. ® (OGC) standards are used for implementation of the services contained in the INSPIRE. OGC is an association of 381 companies, government agencies and universities founded for developing public available specifications and standards. The OGC specifications are interoperable, open and free (Fig. 1).

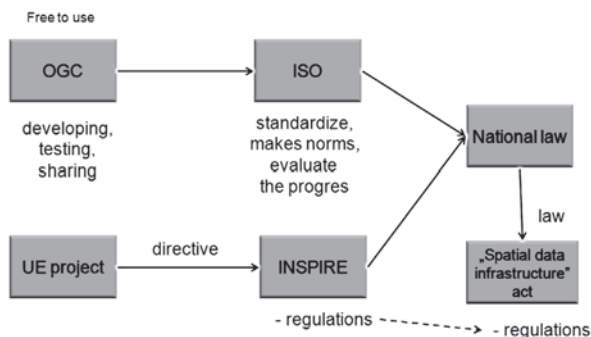


Fig. 1. Schematic relations between OGC, ISO and INSPIRE

2. Building the Spatial Web Services Based on the OGC Specifications

2.1. Data Preparation (Stage 1)

To create the system the data were saved as dgn and gml (with schema) format used taken from master thesis written by Arkadiusz Łukowicz [4]. The files contain the map of Zakłady Górnicze “Lubin” (Mining Plant “Lubin”), part of concern KGHM Polska Miedź S.A. (Fig. 2).

The lack of open source software, able to read and edit gml files, there was decided to use a commercial TatukGIS Editor, which is a “Trial” version (with limited use).

Layers created from the gml source file:

- “*filar_ochronny*” (“*protecting pillar*”),
- “*granica_obszaru*” (“*mining area border*”),
- “*parcele*” (“*parcels*”),
- “*projektowane_pole*” (“*projected panel*”),
- “*wyrobiska*” (“*mining excavations*”).

For the parcels and projected field layers the topology procedure was used. The aim of it was receiving polygon features, The reason: this is the object type for these layers.

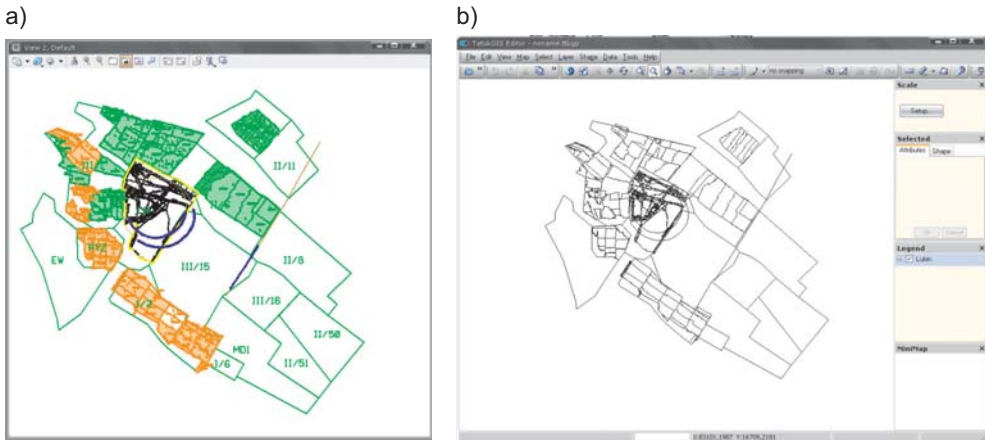


Fig. 2. Map of Zakłady Górnicze “Lubin” (Mining Plant “Lubin”): a) dgn file; b) gml file
Source: based on data [3]

For text labels layers the dgn file was used. They were also read by TatukGIS. The layers were created:

- “*parcel_etykiety*” (“*parcel_labels*”),
- “*projektowane_pole_etykiety*” (“*projected_panel_labels*”),
- “*wyrobiska_etykiety*” (“*mining_excavation_labels*”).

Next, layers were exported to shp data format. This procedure allowed to distinct the point, line and polygon data types and provided to implement further steps.

2.2. Export to PostGIS Database (Stage 2)

In the second stage author of this article has saved prepared geodata to PostGIS database – PostgreSQL spatial extension. The PostGIS mechanism creates possibility of fast and convenient access to stored data. This is the main reason why this database was chosen for spatial web services.

To view and export prepared data there was gvSIG (es. Generalitat Valenciana Sistema de Información Geográfica) used. This program is a multiplatform (written in Java) client for creating and editing maps, distributed under the GNU GPL. (note: The GNU GPL is a recursive acronym for “GNU is Not Unix General Public License”).

Before loading the data, there was coordinate reference system set to EPSG: 2170, Zone IV, which means the Polish Coordinate System 1965. Next, there were shp data files loaded. Figure 3 presenting the data.

Next, there was database prepared: there was new base with spatial option created (using built-in template “*template_postgis*”). Next step the coordinate reference system information record about “EPSG: 2170” was inserted into proper table. Data were exported from gvSIG to prepared database.



Fig. 3. Visualisation of prepared data

2.3. Publishing Spatial Data Using “GeoServer”

GeoServer is a software based on Java Enterprise Edition, which allow to view and transform spatial data. It uses open standards, which makes it flexible for creating and sharing data. It needs only web browser to configure it. First, there was namespace created for new data. Namespaces separates data from different sources. For the following project there was namespace created called “lubin”. Next, there was new Data Store set. In this case the data store is the connection with PostGIS database. When connection was properly set, there were object types defined in GeoServer. These are the layers, which were added to database before. The layers (databse tables) are listed as a combo box like:

datasource_name:::layer (table)

After the new objects type was created, there was style given, coordinate reference system assigned and there was bounding box generated.

2.4. Data Styling and Analysis of the Possibilities of Using the SLD Specification for the Cartographic Symbolization (Stage 4)

For data, which were added to GeoServer, there were simple styles assigned just for pre-view. In order to adjust the map elements of the standards, an attempt to model specific graphic symbols in SLD was made. There was used the built-in GeoServer SLD editor. It provides only validation for compliance with the SLD schema.

Style for layer "filar_ochronny" ("protecting pillar"). For label style there were GeoServer VendorOption parameters used to display text along the line. Unfortunately, this effect due to software limitations is achieved with fairly large scale (approximately 1:300, see Fig. 4, 5). To style line there was Scalable Vector Graphic (SVG) file used. SVG is a markup language for two-dimensional graphics based on XML (Extensible Markup Language [3]).





Lp.	Nazwa znaku	Umowne znaki na mapach w skali				Nazwa barwy wg PN-G-09001:2003
		1:500; 1:1000; 1:2000		1:5000; 1:10000		
		Oznaczenie				
		barwne	czarne	barwne	czarne	
1	2	3	4	5	6	7
6	Granica filara ochronnego					Czerwona „karmin” pełna i rozjaśniona

Fig. 4. Protecting pillar border
Source: [6]

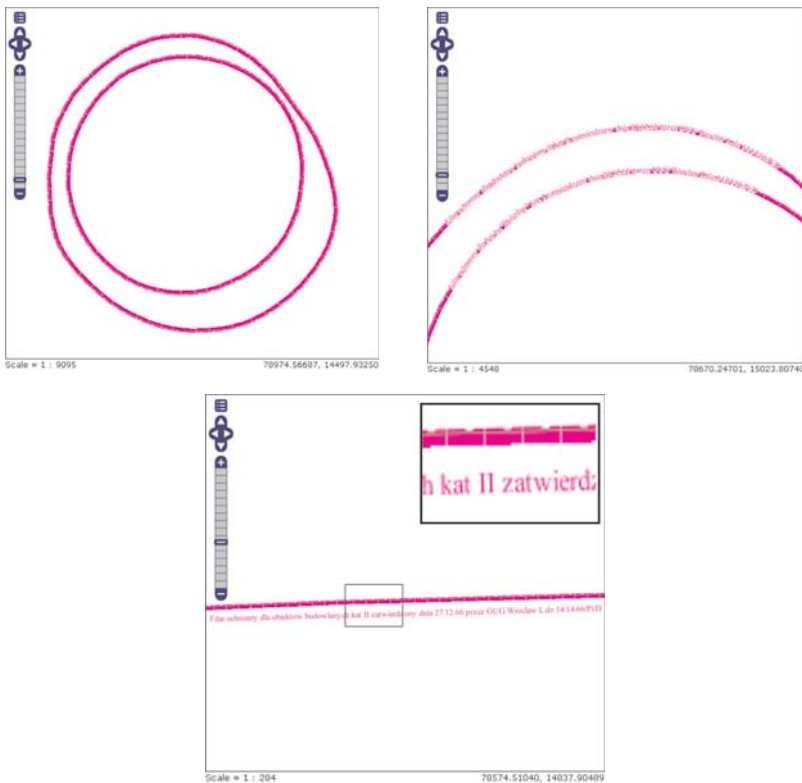


Fig. 5. Visualisation of protecting pillar

Style for layer "granica_obszaru" ("mining area border"). To style mining area border there was Polish Standard used [6] (Fig. 6).

Lp.	Nazwa znaku	Umowne znaki na mapach w skali				Nazwa barwy wg PN-G-09001:2003
		1:500; 1:1000; 1:2000		1:5000; 1:10000		
		Oznaczenie				
		barwne	czarne	barwne	czarne	
1	2	3	4	5	6	7
4	Granica obszaru górnictwa złóż rud metali nieżelaznych					Niebieska „ultramaryna” pełna i rozjaśniona

Fig. 6. Mining area border

Source: [6]

To obtain the line appearance there was Scalable Vector Graphic (SVG) file used. The resulting map portrayal is presented at figure 7.

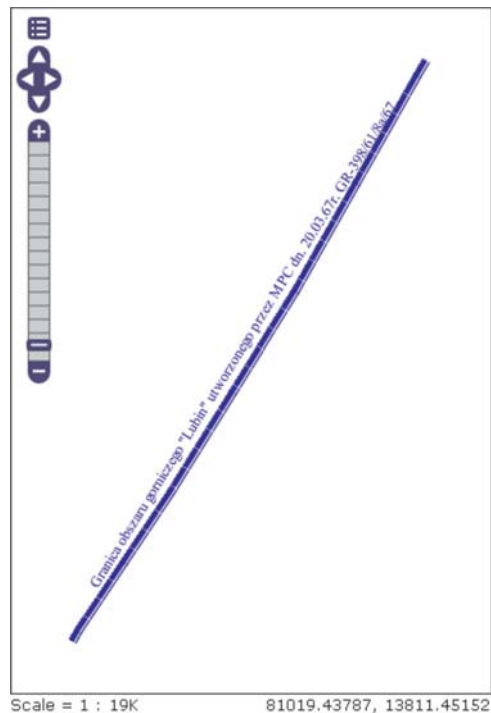


Fig. 7. Visualisation of mining area border

Style for layer *“projektowane_pole_poligony”* (*“projected panel polygons”*) and *“projektowane_pole_etykiety”* (*“projected panel labels”*). To style these layers there was dgn file used. The resulting map portrayal is shown at figure 8.

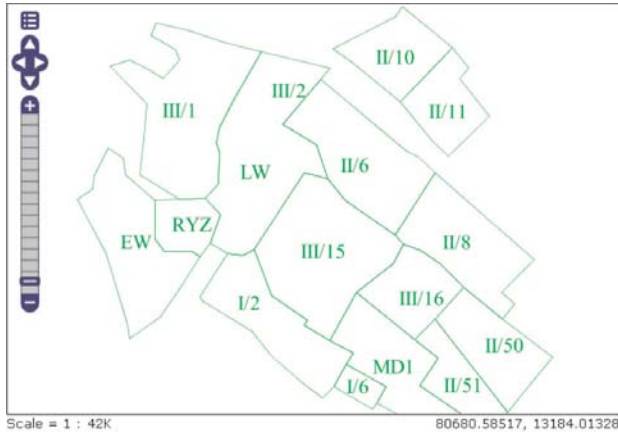


Fig. 8. Visualisation of projected fields

Style for layer *“wyrobiska”* (*“excavations”*) oraz *“wyrobiska_etykiety”* (*“excavations labels”*). To style these layers there was dgn file used. The map portrayal is shown at figure 9.

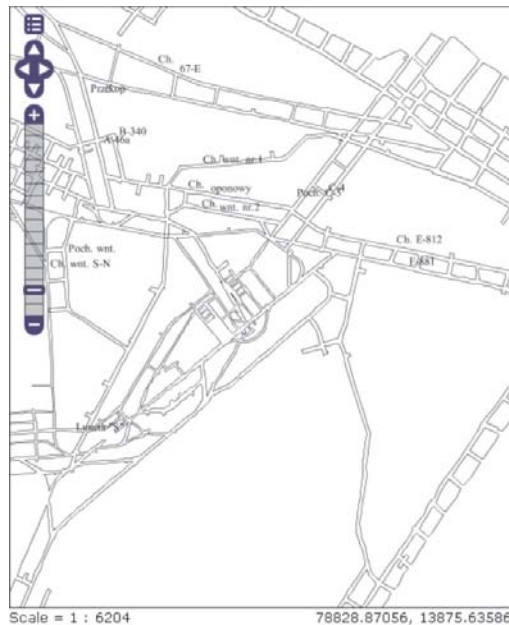


Fig. 9. Visualisation of mining excavation

Style for layer *“parcelle”* (*“parcels”*) and *“parcelle_etykiety”* (*“parcels labels”*). To style these layers there was dgn file used. The map portrayal is presented at figure 10.

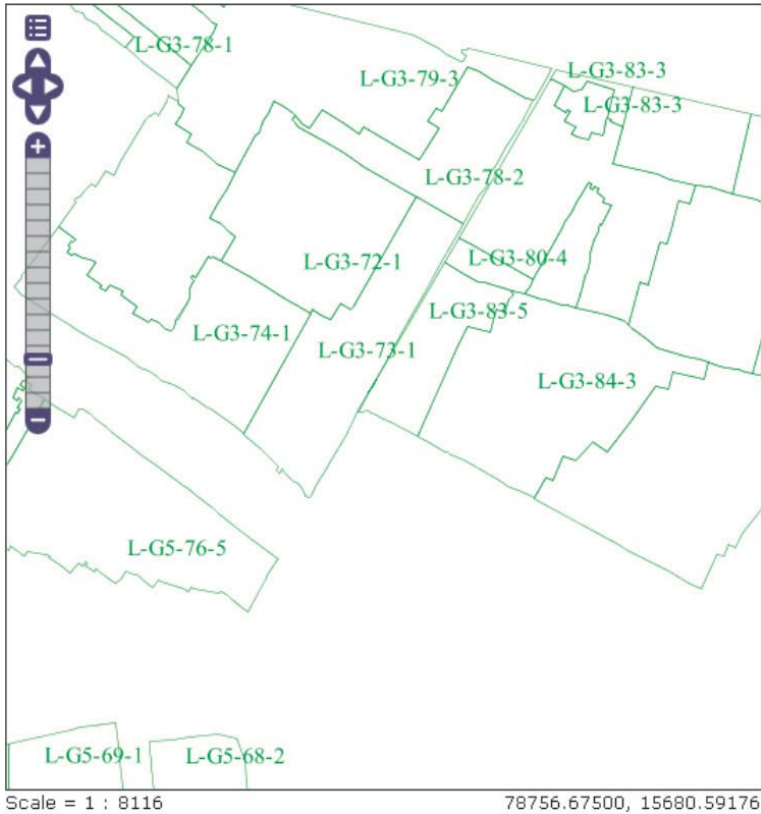


Fig. 10. Visualisation of parcels

Style for parcels fill and an attempt to model the according to Polish Standards. There has been selected three polygon patterns from norm [6] (Fig. 11).

Next, there were parcels selected and filled. These fills are not compatible with real mine, parcels were selected arbitrarily for the study purposes (Fig. 12).

2.5. Application – WMS Client (Stage 5)

The last stage of geospatial web services building was the WMS client creation. To do it there was OpenLayers used. This is the open source library written in JavaScript for publishing maps in the Internet. Using OpenLayers API (Application Programming Interface) there is possible to create complex geospatial internet applications.

Lp.	Sposób kierowania stropem	Pokład lub warstwa	Umowne znaki na mapach w skali			
			1:500; 1:1 000; 1:2 000		1:5 000	1:10 000
			Oznaczenie			
			czarne	barwne	czarne	czarne
1	2	3	4	5	6	7
1		Cała grubość pokładu lub I warstwa				

Lp.	Sposób kierowania stropem	Pokład lub warstwa	Umowne znaki na mapach w skali		
			1:500; 1:1000; 1:2 000	1:5 000	1:10 000
			Oznaczenie		
			barwne	barwne	barwne
1	2	3	4	5	6
8	Wybieranie pokładu systemem komorowo-filarowym z upodatkowaniem złoża i dodatkową ochroną stropu	Cała grubość pokładu			
9	Wybieranie pokładu systemem komorowo-filarowym z częściową podsadzką hydrauliczną	Cała grubość pokładu			

Fig. 11. Seam extraction systems
Source: [6]

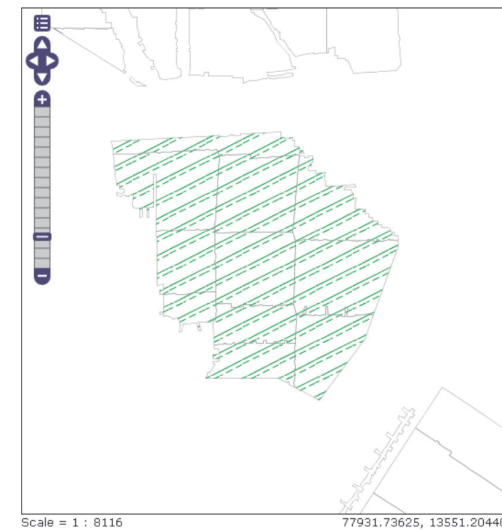
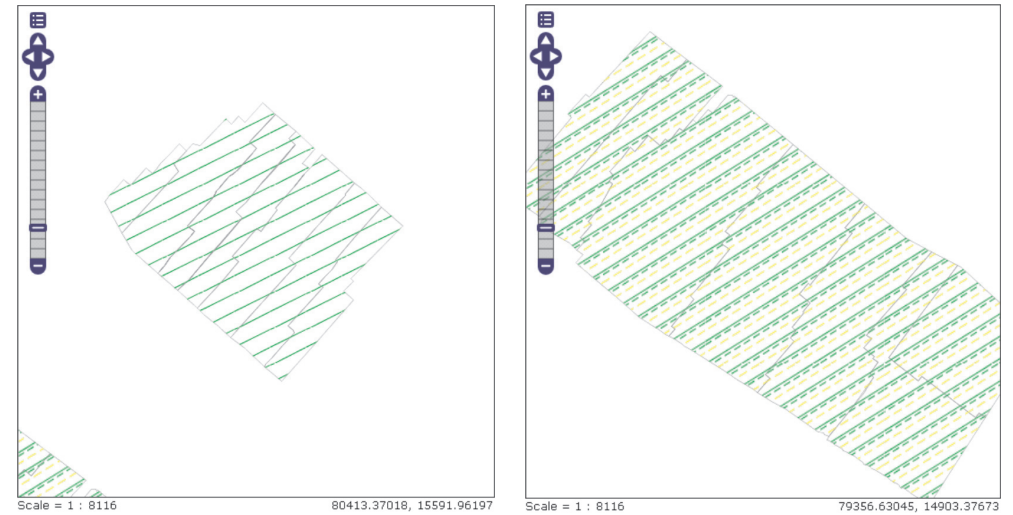


Fig. 12. Parcels fills

Using OpenLayers capabilities there has been a web page created, that includes the library:

```
<script type="text/javascript" src="OpenLayers.js"></script>
```

Next, parameters were set:

```
map = new OpenLayers.Map('map', {controls: [],
    maxExtent: new
        OpenLayers.Bounds(75963,10526,82354,16449),
    projection:"EPSG:2174",
    units: 'm',
    srs:"EPSG:2174",
    scales: [25000, 10000, 5000, 2000,
        1000, 500, 250, 100],
    minScale: 25000,
    maxScale: 100});
```

The WMS layers were defined (parcels layer in listing below):

```
var parcele = new OpenLayers.Layer.WMS.Untiled( "Parcele",
    "http://localhost:8080/geoserver/wms",
    {transparent: true,
    layers: 'lubin:parcele',
    format: 'image/png'
    }, {projection:"EPSG:2174",
    transparent: true,
    maxResolution:"auto",
    srs:"EPSG:2174"} );
```

And the WMS layers were added to map:

```
map.addLayer(parcele);
```

The map portrayal is presented AT figure 13.

Developed application allows data to be accessed using only a web browser. It provides easy and convenient data viewing without any specialized GIS software.

3. Summary

OGC standard and geospatial web services are still not well-known in Poland. Open source software is still being developed. According to fact, that the source code is open it is possible to adjust the software to Polish standards.

Preparation of cartographic symbolisation for mining map required designing and creating the SVG files, which contains fillings and lines definitions. To properly display SVG files on the map, there have been SLD files prepared, which contains rules and constrains for symbols placement.

During project developing there were few problems. One of them was the incompatibility the gml data with the available open-source software. Although the contents of the file has been stored in accordance with the OGC GML standard, none of the "open" programs could not read the data. There could not be the OGC GML standard used for data transfer, so it was the shp format used. This operation allowed non-problem data export to open source database PostGIS, and publishing them with GeoServer. Prepared data in database, loaded to spatial server can be defined as "data system based on the free standards", because transformed data no longer depend on any "closed" and commercial software.

The analyse of possibilities of using OGC standards for cartographic symbolisation according to Polish norms showed that the OGC standards can be applied, but they do not compliance all the demand of cartographic content. The SLD standard does not provide the symbolisation of complex lines and fills. Perhaps future versions of the SLD will allow to use just this standard to style both simple and complex points, lines and fills. However SLD can be used independently without additional resource files.

References

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 - [6] *Mapy górnicze. Umowne znaki granic* (Mining maps. Conventional symbols of borders). PKN, Warszawa 2004.
 - [7] *Mapy górnicze. Umowne znaki podziemnych wyrobisk górniczych* (Conventional symbols of underground excavations). PKN, Warszawa 2005.