

# **The Geoportal of Bavaria (Germany) - Development to 3D-Bavaria in Real Time**

**Günter NAGEL, Germany**

## **SUMMARY**

In Germany the official system of surveying, mapping and geoinformation is organized on a federal level. As an example of this structure the tasks and services of the Bavarian Office for Surveying and Geoinformation – Survey of Bavaria (SOB) are presented with a special view to the internet technology. With his core data SOB has a key role in building up a Spatial Data Infrastructure (SDI) for governmental aspects. The 3D-visualisation is a new challenge. More and more the customer has to be integrated to get highly actual spatial data.

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## 1. FEDERAL ORGANIZATION IN GERMANY



Fig 1: Federal Structure of Germany

On the international level the system of surveying, mapping and geoinformation in Germany is rather strange. In the Federal Republic of Germany the 16 Lander (member states) are working totally independent in this field. Each Land has his own law in this domain. The 16 Lander are working together in the “Working Committee of the Surveying Authorities of the States of the Federal Republic of Germany”. The AdV, that’s the German abbreviation of this committee, looks forward to have common guidelines in Germany and to profit each one from the other. The Federal Office for Cartography and Geodesy – BKG - in Frankfurt is a member of AdV and serves like a provider for the demands of spatial data on the federal level.

To explain the system in Germany the “Bavarian Office for Surveying and Geoinformation” is taken as an example of the 16 Lander. In analogy to the “Survey of Israel - SOI” the shorter term “Survey of Bavaria – SOB” is used in the following article.

Situated in the south Bavaria covers 1/5 of the whole area of Germany. Bavaria is the biggest Land with about 70.000 km<sup>2</sup> and is the second one in population with about 12,5 million habitants.

## 2. HISTORY OF THE SURVEY OF BAVARIA

The history of SOB is going back to the year 1801, the time of the Napoleon Wars. The aim was to get justified taxes from the real estate. Parallel to this political and more administrative cornerstone the Kingdom of Bavaria started to produce topographical maps mainly for military reasons.

It is remarkable that in Bavaria both, cadastral and topographical maps had been based on the same geodetic system. This was a new idea looking far ahead in the future. Totally new was also the arrangement of the cadastral maps in form of a framework with a homogenous scale of 1:5000 respective 1:2500 in the northern part of Bavaria. The cadastral maps had not been

conceived only for the tax income; they should also serve for all kind of administration purposes. In the first time even the 3. dimension was drawn in form of hachure lines.



Fig. 2: Archive of lithography stones in SOB

The maps could be multiplied by the way of lithography. The inventor of this printing method, Alois Senefelder, was the director of the printing division in the former Topographic Bureau. The collection of about 27.000 lithographic stones is unique all over the world and has all characters of a GIS.

### 3. PRESENT TASKS AND SERVICES

Today the cadastral data is stored in a data bank which daily is updated by the 51 cadastral offices. A specialty in Bavaria is that the cadastral measurements only are executed by the cadastral offices. The private sector can use the results for all other purposes of engineering.

The digital cadastral maps and the cadastral book are linked by the system ALKIS (automatic cadastre system) which is constructed as a vector based GIS. The customer can get the real coordinates of the boundary and the buildings. In some areas mainly in forests or in the mountains the coordinates still are based on the old graphical cadastre.

To represent the topography SOB primarily uses the aerial imagery. In a 3-years cycle whole Bavaria is covered with new orthophotos. These orthophotos can be used in a digital way. They are colored and guarantee a 20cm ground resolution of one pixel. Since 2009 digital cameras are used. The additional infra red channel will be very interesting in the environment sector. Infra red is a further element which divers the official aerial imagery from the non-transparent offer of different viewers in the internet.

A precise Digital Terrain Model (DTM) is a prediction to produce homogeneous orthophotos. In the starting time of the orthophotos the DTM was only a means to an end. Now the DTM

became an independent product, which is required by different customers and authorities, e.g. in the flood disaster management.

Since about 5 years SOB produces a precise DTM via laser scanning requiring in average 1 dot per m<sup>2</sup>. The project should be achieved in 2010.

The methods of remote sensing and aerial photogrammetrie today are very comfortable apart of the cost, which are considerable for a country like Bavaria. However a lot of information can not be detected above from the air, e.g. paths in wooden areas, characters and names of streets, nature of using the real estate and so on. That is why still topographers in the field are capturing this supplementary data.

The topographic data flow into the vector based geoinformation system ATKIS (topographical information system). ATKIS is the base for topographic maps which are offered in a digital and in an analogue modus. Independent to the digital products analogue topographic map still will be requested in the future. This is similar to news papers, which will not be replaced by the internet – there is a need for both!

#### 4. SATELLITE POSITIONING SYSTEM SAPOS

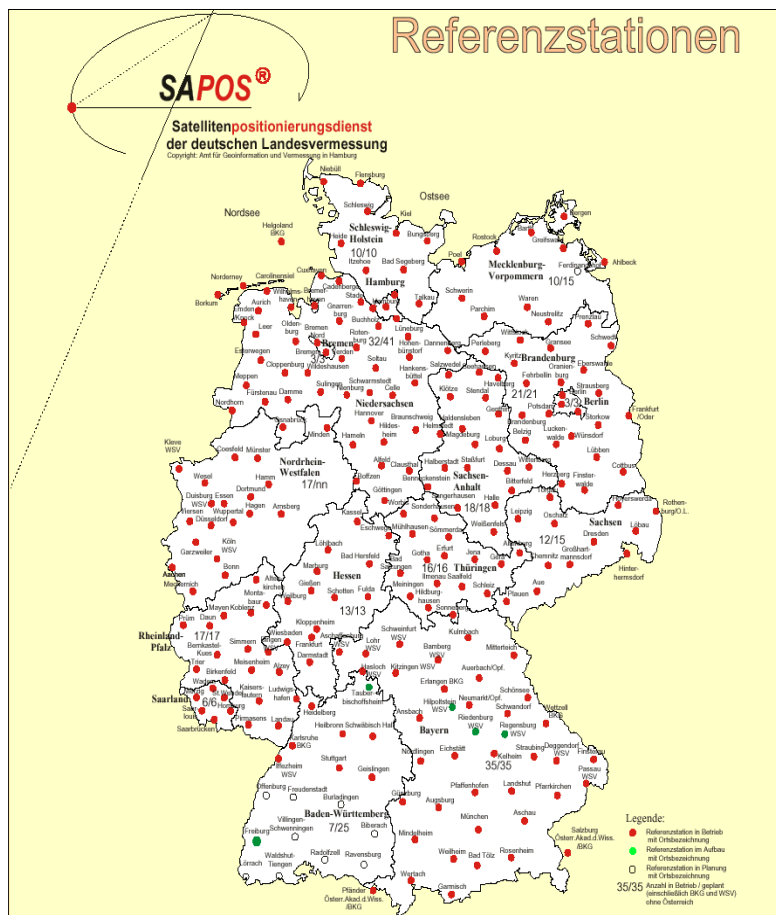


Fig. 3.: Satellite positioning System SAPOS

A GIS must be referenced on an accurate, easy accessible and homogenous geodetic System. It has to be foreseen that communities, other administrations, water and electricity companies and so on must use the same geodetic system. The common georeference is a prediction to combine the different data via a geoportal into a modern Spatial Data Infrastructure - SDI.

In Germany this geodetic demand for a cm-accuracy is guaranteed by the Satellite Positioning System SAPOS, which is a result of the German wide working committee AdV. With 35 permanent stations SOB is processing the differential data for GNSS-measurements in Bavaria.

Along the frontiers the differential data are changed with the partner administrations in Austria, Switzerland, the Czech Republic and the neighbor Lander of Germany.

Further on the data of the permanent stations is delivered to a center in Hannover for national wide purposes.

A very delicate problem is to transform the existing coordinates to the new geodetic system ETRS89. Using 10.000 points of comparison SOB has created an algorithm to come from one system to the other.

## 5. INTERNET PORTAL

The homepage of the internet ([www.geodaten.bayern.de](http://www.geodaten.bayern.de)) offers a lot of information about the organization and the products of SOB. What is the idea behind this shop-window?

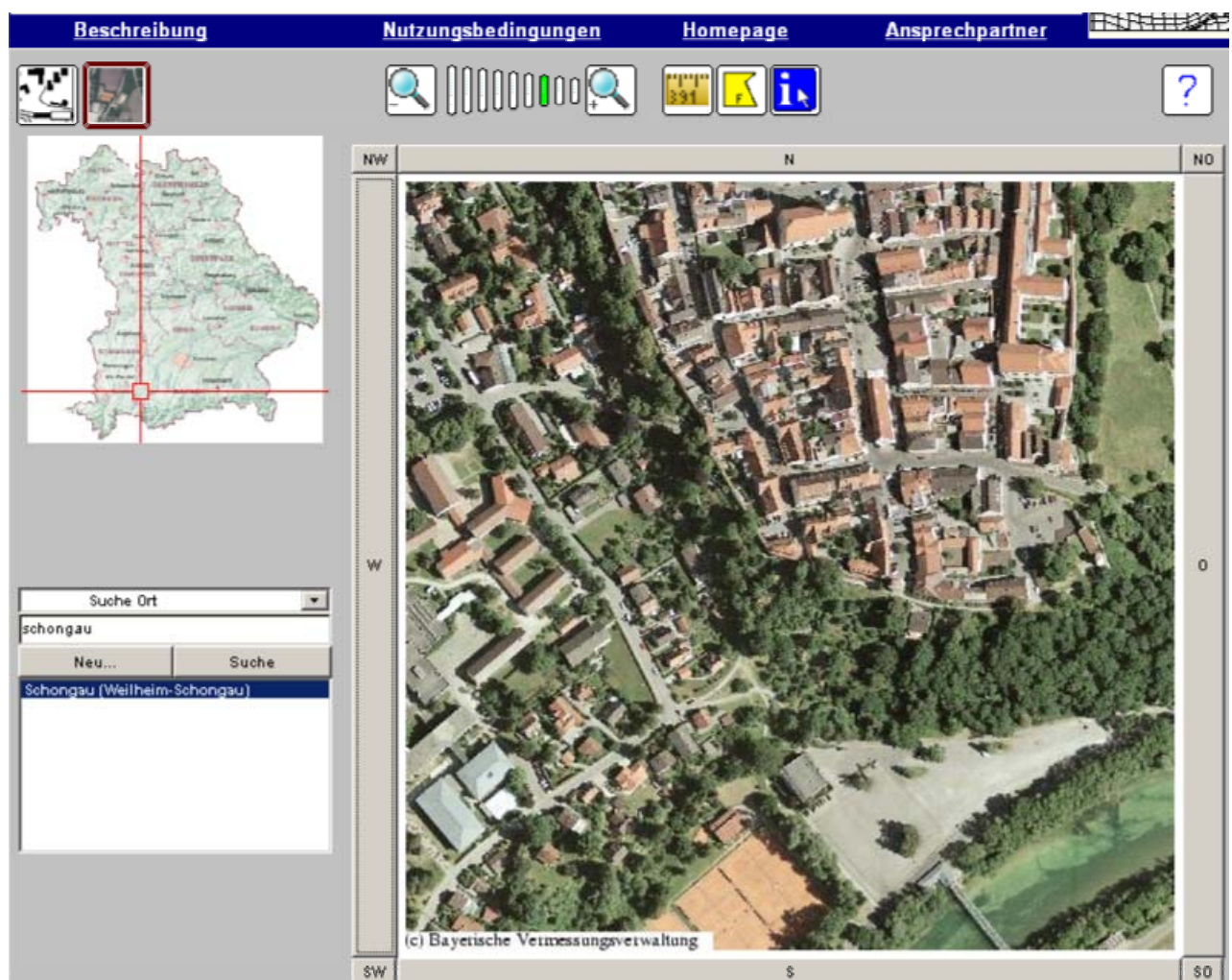


Fig.: 4: BayernViewer, [www.geodaten.bayern.de](http://www.geodaten.bayern.de)

For whole Bavaria the orthophoto can be regarded under a special link. In many cases this is the first step of the visitor to get more information. The accuracy of the visualized orthophoto is corresponding to 40cm ground resolution of one pixel. A view to the topographic map 1:10.000 and to the topographic map 1:50.000 is also free of charge. It is possible to combine these products on the screen and to use different functions like zoom, measuring of distances, arias and so on.

In partnership with other organizations different common projects have already been realized, e.g. the viewer for protected monuments (BayernViewer Denkmal).

For licensed persons or institutions the products of SOB are available via “BayernViewer plus” in a higher quality including the addresses and the cadastral map. This special service which is not free of charge offers the orthophoto in 20cm ground resolution of one pixel.

The most detailed product is the digital cadastral map online. This service is mainly used by communities, banks, notaries and in the constructing field. Even the real coordinates of the boundaries and the corners of the houses can be received. To know, who is the owner of a parcel, this demand requires a special permit.

Like being in the center of a spider web the mentioned products are essential to build up a SDI in Bavaria. That’s why SOB takes a key role in the discussion around the theme SDI. An independent SDI-bureau installed within the SOB has the function to coordinate the interdisciplinary interests and to build up common standards. This small division takes also care for the European project INSPIRE (Infrastructure for Spatial Information in Europe).

It is most important to know, that the special data, for example those for the protected monuments, still are kept by the authorities, which are responsible for this domain. SOB, only offers the platform for the special data!

## **6. 3D-PRESENTATION**

For centuries topographers measured the landscape 3dimensional. The cartographers pressed the results flat into a 2dimensional map. To give a 3D impression they used shadows, contour lines, different colors and so on.

In the cadastral field the 3. dimension was not relevant. The cadastre was tax orientated with the idea that the whole property of a parcel belongs to the owner including the parts below and above the surface, projected to the central point of the earth.

Since several years it is possible to handle 3dimensional models in a digital way. The internet technology pushes the demand for 3D-products.

To allow a broad access to 3D data the Open Geospatial Consortium (OGC) is standardizing the Web Terrain Service (WTS) and the Web 3D Service (W3DS). WTS is an extension of the Web Map Service (WMS). In principle, WTS provides perspectives which allow the presentation of maps from different angles of view. W3DS was developed as an extension of the WTS and used for interactive visualization of 3D spatial data.

In this context the project CityGML (City Geography Markup Language) has to be mentioned. CityGML shall be an OGC-standard with the aim to store and to change virtual

city models.

Supposed CityGML is an accepted standard, who gives the data input and who keeps the data? What is the role of institutions like SOB in this context?

The DTM can be used for manifold purposes, for example in the flood disaster management. However the DTM has no evidence for all objects above and below the raw surface of the earth.

The first pulse of the laser scanning data allows creating a Digital Elevation Model (DEM).



Fig. 5: City model of Munich

Using the following data

- Orthophoto
- Digital Terrain Model (DTM)
- Digital Elevation Model (DEM)
- Surrounding lines of the buildings (coming from the cadastre)
- Partial supplementary photos for a better visualization of the facades a vivid city model can be produced automatically. It is a big challenge to bring the result of this input into the structure of CityGML. The first reasonable step will be to create a block model, this means level of detail 1. The average height of the buildings comes from laser scanning, the surrounding lines from the cadastre. Modeling the roofs – level of detail 2 – will be much more difficult.

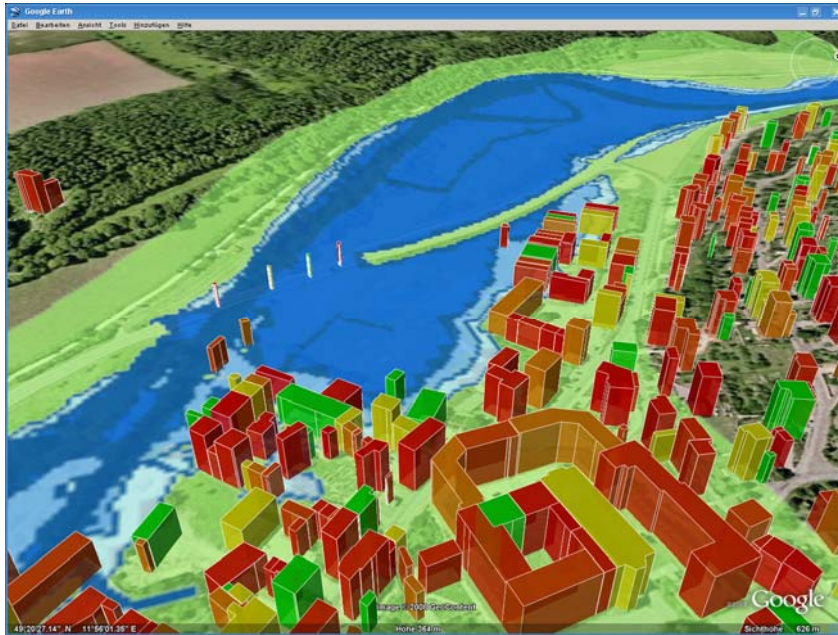


Fig. 6: 3D Block Model exported to Google Earth

SOB implemented in a test phase a web 3D service compatible with WTS and WMS. This service provides in real time dynamic and static 3D spatial data inclusive terrain model, 3D buildings etc. Several features of this service are:

- Full automation: The generation and update is implemented automatically.
- Coverage: The service is available for whole Bavaria (about 8 million buildings).
- Continuous update: The 3D data is generated in real time and has the same actuality as the underlying data.
- Standard conformity: It supports three new 3D formats, KML, CityGML (de jure standard) and 3DPDF (de facto standard). Moreover, the required clients such as Google Earth and Adobe Reader are very popular.
- Interaction: It can support animation, navigation, identification and spatial semantic queries etc.

## 7. PERSPECTIVE

Laser scanning together with aerial imagery and cadastral data may give a starting point for 3D city models whatever would be the level of detail. The actualization of the data demands another way; the inclusion of the “data producer”.

Normally the community or a special authority approves the plan of a new building. If this plan will be conform to the standard of CityGML the planned building could be used like a brick in the 3D city model. This kind of modeling could be an interesting field of activity for private surveyors.



Laser scanning and aerial imagery can not be a solution to actualize the 3D data in short terms. This would be too expensive, especially laser scanning. These are good methods to verify the data from time to time. SOB stakes on the 3years cycle of the aerial imagery and the methods of change detection. A new laser scanning campaign may come in question in some special arias but not for the whole country. Especially the cadastral information will serve for the short term actualization.

In future the elements of updating more and more will come from the data producer. This idea shall be explained by the example of roads:

The road administration is responsible for constructing and maintaining roads. For this issue this authority keeps his special data which

- must be based on the common geodetic reference system. This challenge is guaranteed by the Satellite Positioning System SAPOS.
- has to respect defined standards coming from the SDI-sector.

Provided, that these conditions are fulfilled, SOB and also other authorities can use the road data for other purposes, for example to actualize the topographic data. The new data even can be used in a planning phase which is not possible above from the air. After having realized the road project the data has only be switched from “red to green”.

In the topographical field even the private user can give an input for a high actuality of the data. The internet portal “Open Street Map” is an example for this development and doubtless has advantages for many purposes. However organizations like SOB will keep their role in the field of a professional spatial data infrastructure. For governmental aspects there must be an authority which guarantees certain content and a high quality of the spatial data! The core data – geodetic network, cadastre, orthophoto, DTM, topographical maps - furthermore has to be kept and verified by organizations like SOB!

However organizations like SOB need partners to get an actual and standardized updating. The whole community of FIG is an important partner, who has a rich field of activities to build up a SDI which will be a big marked for manifold purposes all over the world.

## BIOGRAPHICAL NOTES

Prof. **Günter Nagel** from Germany is the Past President of the Bavarian Office for Surveying and Geoinformation (Survey of Bavaria).

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