Local SDI

Collaboration on SOA

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SUMMARY

The rising demand for online spatial data is a great challenge especially for small municipalities. The limited capabilities encourage the stakeholders to look for new solutions. The process of capacity building even in the super ordinate administrative levels has to be established first to launch the use of geospatial data online. A project from the state Hesse initiates a local cooperation, which unite providers and users of a Spatial Data Infrastructure (SDI). The main goal of the project is to establish a local SDI and support the municipalities during the implementation of the INSPIRE directive. The project forms the foundation for the joint venture "GDI-Südhessen" which continues and expands the work during the project. The concept defines the organizational framework for a long-term cooperation. The GDI-Südhessen incorporates four districts, two cities, one regional association and the state Hesse. Additionally the "Institut für Kommunale Geoinformationssysteme" (IKGIS) at the Technische Universität Darmstadt supports the cooperation with scientific monitoring and support. Through the establishment of a reliable structure the project could be transferred into a permanent institution, which will be described as follows. Beyond the technical requirements the cooperation has the capabilities to analyze and annotate the INSPIRE process. The focus is always the impact of INSPIRE on the work of municipalities.
Further on this text pictures the technical requirements as well as the concept and implementation of SDI by means of the service chain to discover a land-use plan as the first step to a Service Oriented Architecture (SOA) for geospatial data in a municipality. Additionally, the paper gives an outlook to further possibilities for municipalities using SDI to develop user-oriented offers in planning and administrative processes. Based on the use of the latest geo standards and map viewers out of the Web 2.0 sphere user-friendly SDI-applications can be developed. A case in point is a service for citizens in the city of Wiesbaden which is under development. This example demonstrates the potentialities in extensibility and access via mobile interfaces.

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1. Local SDI in terms of INSPIRE

Geospatial data supports decision making processes in the private business as well as in the public administration and became a key source in the information society. Normally, the data are widely spread over multiple independent sources and is not exploited fully.
In contrast, all public administrations are encouraged to offer cost-efficient new services to the citizens based on the goal set by the European Union in 2000 and 2005 (Osimo 2008). To develop and provide this services a cooperation between municipalities could be a cost-efficient solution (Köhler 2010).
The pilot project "GDI-Südhessen" focuses on publication of geospatial data by creating a network based on the idea of the European INSPIRE Directive (EC No 976/2009). The GDI-Südhessen is a regional project with partners on local and regional level of the public administration and has the target to build the foundation for a local Spatial Data Infrastructure (SDI) in the south of Hesse.
The main goal of the cooperation is the generation of new capacities to enable the use of local SDI in the local government. Through the cooperation the partner are encouraged to include SDI functionalities in their own administrative processes independently.
The design of the cooperation includes practical implementation of a Service Oriented Architecture (SOA) as well as the capacity building for all participants of SDI including politicians and staff in the administrations. This capacity building is a continuous process through regular meetings in working groups and through workshops for the other participants as well. The main topics of a SDI are documented in framework documents which have been generated in collaborative work and could be used as a guideline for further projects.

After successful establishing a local SDI various task in local Government could benefit and many applications could be improved considerably. Especially the municipal planning and public administration might benefit from local SDIs.
For many municipalities in Germany it is increasingly difficult to fulfill their tasks. One reason is the monetary tightness along with staff shortness (Statistisches Bundesamt 2009). Furthermore, the municipalities in the German state have to deal with a significant number of services besides the local self-government (Püttner 2000; Hill 2005).

Improving the procedures in municipal planning and administration by a better involvement of geospatial data provided by local SDIs, local government could benefit in terms of increasing their efficiency:

1. Establishing SDIs allows an enhanced distribution of qualified geospatial data. Qualified geospatial data in turn are an essential part of decision making in administrative and planning processes in municipality.
2. OGC Geo Standards ensure interoperable access to geospatial data as an important aspect and a prerequisite for increased effectiveness. Geospatial data from local SDI

could be easily used from different departments over the internet or intranet independently from any software system utilized.

3. By the use of standards local SDI might become an integrated part of the municipal E-Government platform. Improvements in E-Government are an important goal of municipal administration in future.
4. Integrating spatial thematic data within the framework of a local SDI ensures the persistent storing of the data gathered. As result geospatial data needs no longer to be stored locally inside the department's IT structure. Furthermore the data from one department might be useful for other departments accessing the data by local SDI.
5. The availability of and the easy access to qualified geospatial data as well as different kinds of spatial thematic data enable further analysis and new applications within municipal planning and administration tasks.

On the basis of these considerations applications in municipal administration which could benefit from local SDI are introduced.

2. Discover a land-use plan

To increase the technical knowledge in SOA the workflow to discover a binding land-use plan was chosen. Land-use plans are one of the main tools of spatial planning in Germany. The design and implementation of such a land-use plan is under the independent responsibility of the municipalities. Every partner is touched by this planning topic and therefore this workflow was selected for the development of a service chain to find the information for a given plot of land. This simple example is based on the definition for SOA from OASIS to solve a problem by using the capabilities offered by someone else (OASIS 2006).

By using the address or plot number the system should present the detail information of the land-use plan for this location. Apart from the technical interest the citizens focus on the development of their city as well and the participation and response of the users improves the future design of new services. The process combines SDI components like Web Processing Services (WPS), metadata search via Catalogue Service for the Web (CSW), Web Map Services (WMS) and map viewer. All services follow the OGC specifications (OGC 2011) and enable an integration and combination of services with standard procedures. However the integration of different software products over all administrations pointed out that the way to a standardized automatic workflow is a challenge. The search starts by entering the address of the requested location. The address is geocoded to retrieve the coordinates. Because the installation of Universal Transverse Mercator (UTM, EPSG: 25832) system as new national coordinate system and the historical but in Germany still used Gauß-Krüger system (GK, EPSG: 31467) the coordinates have to be transformed to UTM. The combined viewing of UTM based and GK based services at once is not possible. Therefore UTM has been defined as the main coordinates system in the process even if most of the services support several alternative coordinate systems.

Based on this coordinates the search in the metadata catalogue for Hesse identifies all WMSs for the area. The metadata catalogue for Hesse is a catalogue for spatial information provided and hosted by the federal government of Hesse. It provides a Web frontend as well as an Application Programming Interface (API) to send requests via the OGC protocol CSW. All WMSs are identified by their bounding box deposited in the metadata catalogue. Afterwards

each WMS will be checked if a land-use plan is available for the plot of land requested. This request uses the standard GetFeatureInfo-request for WMS to get the information about the existence of a land-use plan. The positive answer of the WMS results the generation of a Web Map Context document (WMC) for the map viewer. The external hosted map viewer gets this WMC-document and integrates the WMS to present the requested plot of land. Additionally several services for instance satellite imagery or protection areas are integrated (see Fig: 1).

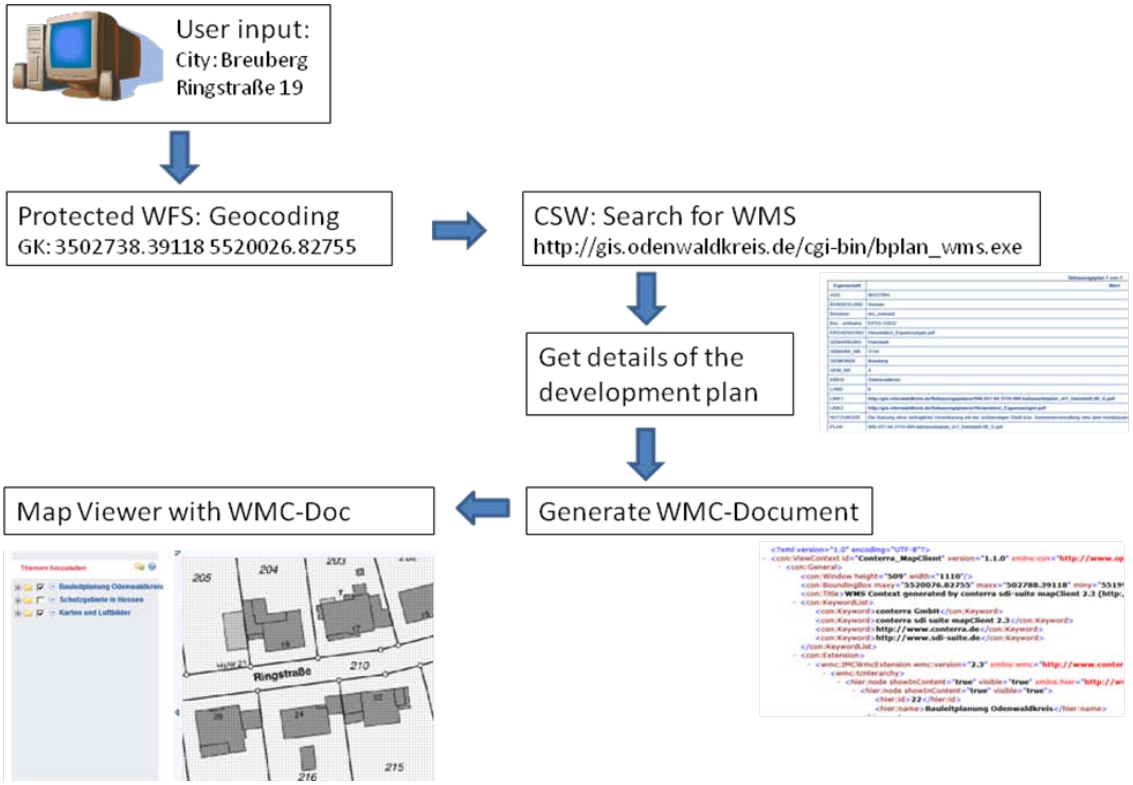

Figure 1: Technical workflow: Discover a land-use plan

2.1 Challenges

By working with different software products in combination with the own development several problems arises. The partners in the project use commercial products as well as open source solutions. The interaction between different solutions and providers points out the gaps in implementation of the OGC-specifications for WMS (OGC 06-042). During the project the WMS –Version 1.3.0 was published. Due to the fact that not all products are able to implement the new version compromises and workarounds have to be developed. Even more than five years after the first publication of the WMS specification not all products are able to support this service without inconsistencies. Therefore the service chain still relies on Version 1.1.1 up to now.
Especially in a SDI different persons are responsible for the services. More than ten services are included in the automatic service chain (10/2011) and therefore the communication to fix

bugs takes time. The permanent exchange between the partners reduces this problem to a minimum and points out the challenges if the INSPIRE process forces communication all over the European Union.

3. SDI-based Citizen Service for improved Participation

In cooperation with the capital of the Federal State of Hesse, Wiesbaden, the idea has been taken up starting with the development of prototypical applications using a local SDI as part of the future municipal E-Government portal.
As a first application, an E-Partizipation service is implemented to enable Wiesbaden´s citizens to inform the city administration about infrastructural problems – in first step lamps and trees along public roads. By using this service the reporting citizen does not have to look for the telephone number of the right contact person in an inconvenient way or to send the incident's location imprecisely by a free text posting to an anonymous email address (without knowing the recipient and without notice of arrival).

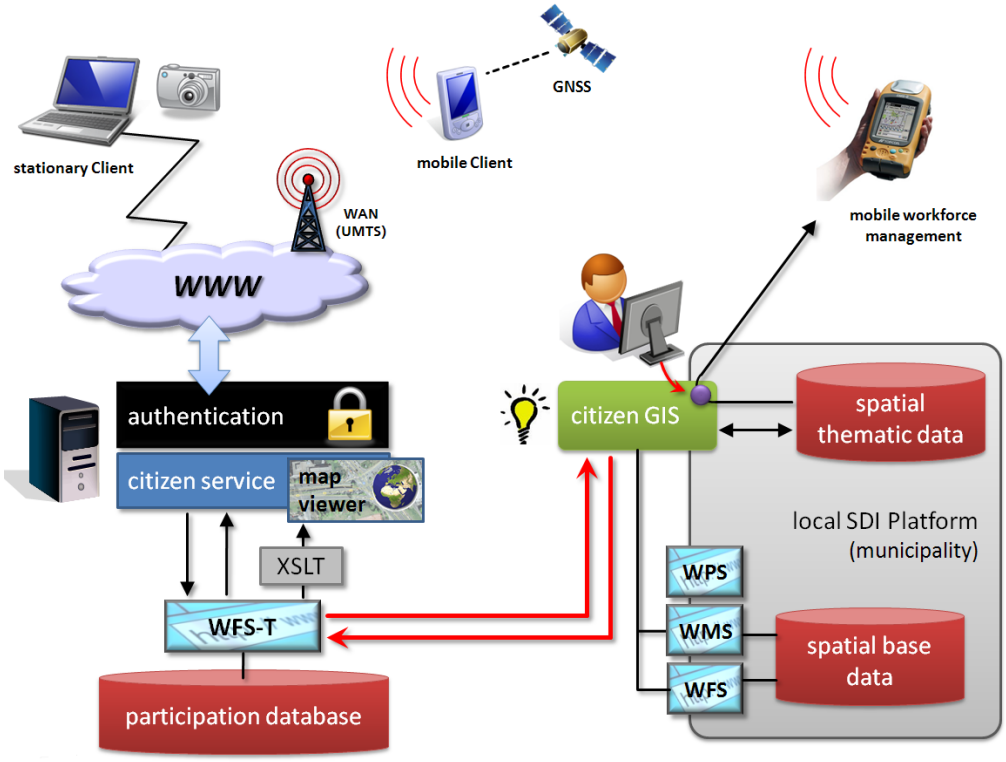

Figure 2: Ideal architecture of the citizen service as application of a local SDI (Blankenbach & Schaffert 2010)

Furthermore, recent developments in the World Wide Web ("Web 2.0") has lead to the phenomenon that people getting involved and taking part in social networks, online games (e.g. Geocaching) or geo services (e.g. OpenStreetMap) on a voluntary manner. Voluntariness and the involvement of people is the crucial aspect for successful participation within a

citizen's service. Unlike existing applications with similar functionalities (e.g. Mängelmelder 2011), the idea therefore is to combine both, the principle of Web 2.0 and the concept of a local SDI, to take optimal advantage for an efficient citizen service (cf. Blankenbach & Schaffert 2010). As result the citizen service which is called "Bürgerservice" is supposed to become an integral part of the municipal SDI within the city's E-Government structures by the use of OGC geo standards.
Figure 2 shows the proposed ideal architecture of the citizen's service as an application of the local SDI

3.1 Architecture and function principle

The idea is to enable citizens reporting infrastructural problems over internet using a web application. Therefore the user starts the application by entering the service URL in the web browser of his home computer and after authentication (for avoiding misuse) a report can be done online. Besides the descriptive report information, an integrated map viewer is used for exact geolocalization and the graphical view. One of the main tasks of the user interface implementation was not to deter potential users, but to animate them for getting involved. The basic idea therefore was to keep it simple and intuitive usable enabling everyone to carry out a fault report. For that reason besides a well-considered input form, Web 2.0 map viewers like Google Maps and OpenLayers are utilized and evaluated. After submitting, the report is stored via OGC interfaces to a geo database attached to the local SDI (see Fig. 2).
The OGC interface of the local SDI also enables the direct access to the report data base from the city´s GIS applications (see Fig. 2). By merging the report with specific municipal geospatial data (e.g. relating to the public roads), SDI-derived spatial base data (plots, traffic zones, etc.) and GIS analysis the contact person might have the ability to check the report´s integrity and set an editing status. Subsequently, he could delegate work order on a GIS level to the field staff, verifying and solving the reported problem on-site. Additionally, he could monitor the work process and manage the report´s digital status. After the problem is solved, the report ought to stay for a predefined time period in an active mode (e.g. seven days) and is then deleted from the data base automatically.

3.2 Implementation

The frontend (and user interface) of the service is implemented as web page consisting of an input form and a map viewer. Choosing a predefined category and optionally attaching additional text as well as a picture of the incident, the problem could be described very easily by the citizen (Fig. 4). For geolocalization the incident is marked in the integrated map viewer. Furthermore, already existing reports within the selected area are shown in the map viewer to prevent multiple reports of the same incident. Traffic light indicators (red / yellow / green resp. blue) mirror the processing stage in order to make the processing stage transparent (Fig. 3).

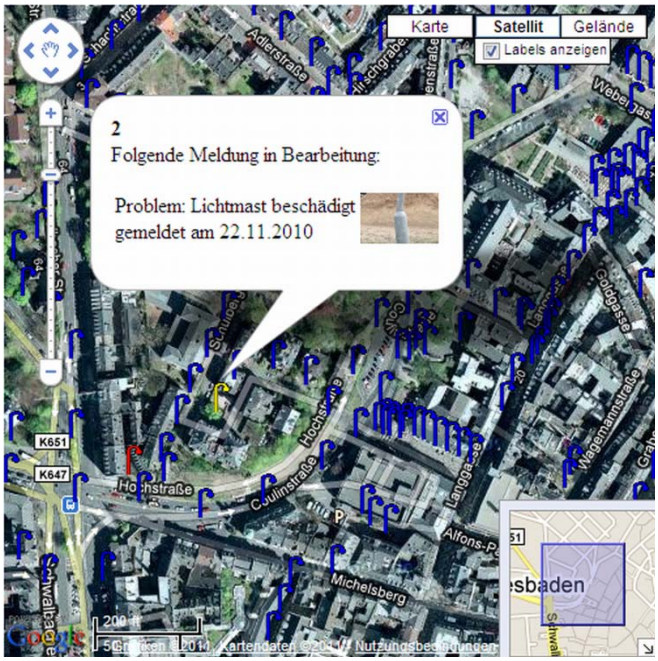

Figure 3: Visualization of geocoded fault reports in Google Maps (Gibitz 2011)

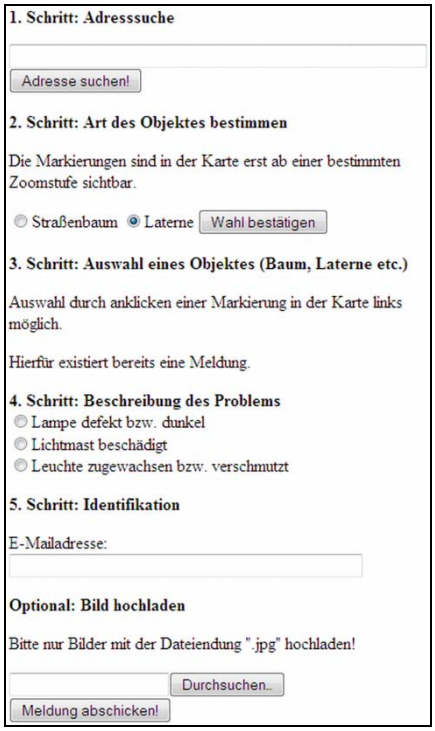

Figure 4: Web form for fault reporting (Gibitz 2011)

The backend is composed by the OGC geo web services of the local SDI. For this purpose the geospatial feature of interest (trees and lamps), which were already digitally stored in the cadastral information system, were migrated to a geo database (Oracle Spatial). For bidirectional and interoperable access to the features, a transactional Web Feature Service (WFS-T) was deployed. In addition the official orthophotos and city map are accessible over a Web Coverage Service (WCS) chained with a WMS.

3.3 Versions

In first version Google Maps was utilized as map viewer (Fig. 3). Therefore the frontend was developed as dynamic HTML page by the use of the Google Maps javascript API (Google Maps 2011). The advantage of this approach is the possibility to use the basemap (orthophotos, streetmap or hybrid) of Google Maps directly without requiring underlying official data. Thus, the features of interest were queried from the WFS, transformed by an eXtensible Stylesheet Language Transformation (XSLT) to GeoRSS format and displayed directly as Google Maps layer. For changing the features status an additional server component (servlet) was developed interacting with the client.
Despite the straightforwardness of this approach, the main disadvantage is the geometrical deviation between the Google Map basemap and the overlayed features of interest due to different spatial reference systems used.Thus, in current version Google Maps was replaced by OpenLayers (Openlayers 2011), which provides an opensource javascript library to load,

display and render maps from multiple sources on web pages (Fig. 6). As basemap the official municipal orthophotos (with identical geodetic datum as the features of interest) accessed by a chained WMS-WFS were used. Moreover the features of interest can now be accessed directly as vector overlay also enabling the features' status manipulation by the use of the transactional WFS interface (Fig. 5). Furthermore, the exclusive use of own data within OpenLayers avoid any license issues that would arise immediately when using third party data distributors like Google.

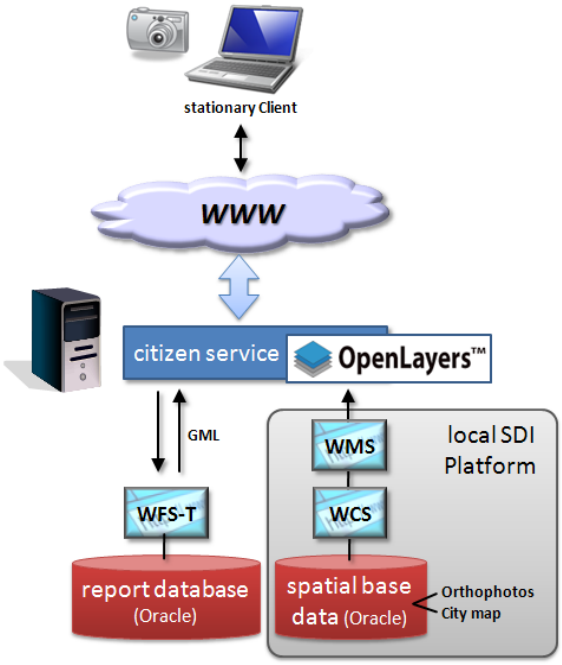

Figure 5: Current citizen service software architecture

Figure 6: OpenLayers client for report visualization

3.4 Mobile extension

The inhabitants of the city using the citizen service described above are going to be provided with a mobile access to the platform. It enables them to call the municipality´s attention quasi at walking past and on site by the use of a cell phone. This mobile interface requires fewer manual tasks, which in turn reduce time requirements and sources of error. Currently, the mobile interface is implemented through developing a client application running on almost every cell phone. Similar to the "stationary" version the users select a topical category and entering free text. The reports geocoding and its picture documentation aimed to be done seamlessly using the smartphone´s embedded sensors, in this case GPS-receiver respectively its camera.

4. E-Participation instruments in the course of municipal planning

The citizen service described above can be understood as application of local SDI as well as modern E-Participation instrument. Provided with similar functionality this instrument could

also be used in municipal planning processes. As E-Participation instrument it enables citizens to take part in planning processes via the internet (one-stop non-stop). By the use of OGC interfaces the citizen´s criticism, comments and suggestions can be written in a database which is deployed in planning processes. Similar to the functionality of "Bürgerservice" the E-Participation instrument allows the geocoding of the citizen's remarks in a map viewer. Again, traffic light indicators can be used to inform the citizen about the planning processes stage.

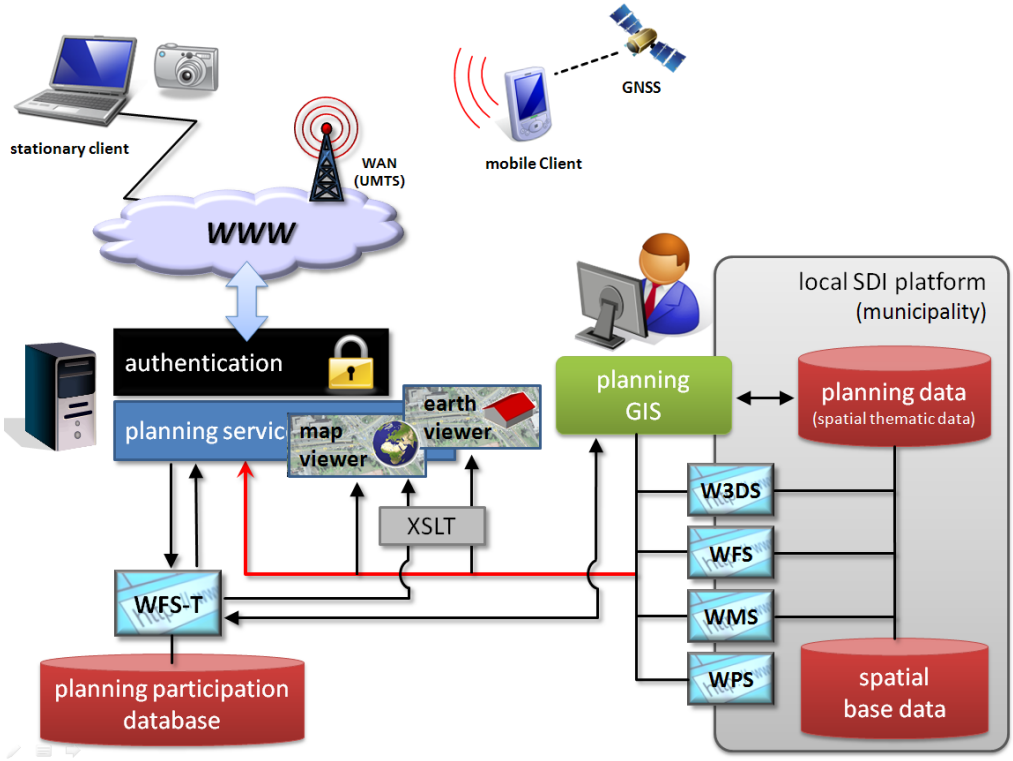

Figure 7: SDI based planning service for municipal planning (Blankenbach & Schaffert 2010)

To meet municipal planning demands, additional interfaces to spatial base data or qualified planning related data – e.g. by using of additional local SDI´s geoservices – are required to visualize a plans consequence in the map viewer. Enhanced visualization techniques like 3D representations, which could be applied with the aid of appropriate 3D services (e.g. Web 3D Service, W3DS) and file standards (e.g. kml) could facilitate the use of Earth Viewers like Google Earth and support the user´s imagination. In addition, the planning department could benefit by employing the same database via OGC interfaces. This would allow the check or evaluation of the citizen´s remarks and enrich the planning process with people's knowledge. Again, a mobile extension is reasonable, because it enables the user to evaluate and comment a plan´s consequence on site.

5. Summary and outlook

The prototype of the SOA "searching a land-use plan" with multiple different providers with the integration of multiple municipalities is not a main access point to discover a land-use plan. Most of the citizens try to get the access to land-use information via the Portal of their municipality directly. But through this project many problems and challenges could be pointed out and based on this experience several independent new services have been installed and are offered to the citizens. The project gets the partners ready for the INSPIRE-process which relies on the knowledge in all municipalities and the keeping to standards. The use of standards like OGC is essential for the interoperable access and is still a requirement to all providers. The partners benefit from the collaborative capacity building as well as from the exchange of experience and continue creating new services independently.
The citizen service "Bürgerservice" represents one example of value added applications of local SDI for municipalities. Many other areas of application (e.g. in municipal planning tasks) are also conceivable. The "Bürgerservice" implemented in cooperation with the City of Wiesbaden is currently being evaluated by the city's personnel and is going to be used for internal municipal tasks at first. The further development addresses the service refinement (e.g. in terms of browser support and robustness of web service integration) as well as the expansion (e.g. to mobile phones).

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