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OGC Services

Emergency Routing with OpenLS RouteService

3D Visualisation with W3D

in the

GEOSS Architecture Implementation Pilot – Phase 3 (AIP-3)

Kickoff Response Due Date: 3 March 2010

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University of Heidelberg, Chair of GIScience
Response to the GEOSS AIP-3 CFP

1 Overview

The GIScience Working Group is willing to contribute to the GEOSS by offering OGC services which have been developed in the context of different research projects. In regard to link researchers, decision makers, data-providers and all further potential users we develop standardized web services that are part of a spatial data infrastructure (SDI). In this context we'd like to contribute following services:

- Emergency Route Planning Service with OGC interfaces (OpenLS route service) in pilot region e.g. Europe or the Caribbean (e.g. Haiti+ Dominicain Repubkic) with user *generated* geographic data. (in general any region can be provided if needed, but we would prefer to provide the available services covering Europe and Haiti/DomRep)
- Emergency route service (also same OpenLS route servie spec) for the African continent with geodata provided by the UNSDI WFP supporting transports in crisis areas.
- The W3DS (Web 3D Service) integrates the interactive visualization of digital terrain models into the spatial data infrastructure for better understanding and analyzing real world issues. The possibilities of getting insights of an area visualized in 3D with the W3DS clearly outrage the possibilities of classical 2D maps.
- 3D SE (3D Symbology encoding) allows for user-defined visualization options in context of 3D landscape and city models. In regard to 3D digital terrain models, 3D visualization options are needed to truly empower visualization advantages of digital terrain models.

2 Proposed Contributions

2.1 Societal Benefit Area Alignment and Support

The Emergency Routeplanning Service with user generated data for the Caribbean and for Africa is thought to be integrated as part of the Disaster Management Section. The benefits of the service can be constituted in several levels. The service supports transports in crisis areas though it finds the shortest path between different spots. Though in case of disaster management it happens streets can't be passed by vehicle, there is the option to define "avoid areas". Those areas mark an area respectively a street as impassable. The service routes around this areas and calculates the shortest or fastest path to the destination. Emergency workers can uses this service to mange logistic and supply of disaster areas. Further the service allows emergency workers to generate "up to date" data which is needed by different section of emergency help. For example it is possible to

generate the avoid areas via a web interface. Further it is possible to mark emergency camps or damaged buildings. This information can be used by all organizations to manage their emergency activities.

The W3DS and the 3D SE can be used in all scenarios by the GEOSS to visualize different matter of content. The W3DS generates a 3D model while the 3D SE offers visualization options for this model. Especially in regard to satellite data, data can be mapped on a digital terrain model which makes the model appear like a "real world" section. The user can interactively navigate and fly through the model and get an overview about the specific surrounding and topography of the area. This can help decision makers to get insight about areas that are not directly known. Following activities can be optimized in regard to information extracted from this model. Next to visualizing a more realistic picture, the 3D SE is able to visualize thematic content. For example, this might concern classification of areas in regard to the density of woodlands or agricultural aspects. Besides this, every thematic issue can be mapped on the terrain model. Specific options allow the visualization of typical DEM analysis functions, such as slope, aspect, hillshading or isolines. The linking of thematic content and the underlying terrain leads to more conclusion compared to classical 2D visualization. Further different modes of navigation can be used in the W3DS-Client. Our implementation of the W3DS client for example offers an automatic "fly through" that follows a pre-defined route to show certain users specific areas. This can help decision makers to show certain aspects of the area to engaged assistants.

2.2 Component and Service Contributions

OpenLS RouteService

UNJLC Africa Routing

The UN Joint Logistics Cluster (UNJLC) is mandated by the UN Inter-Agency Standing Committee (IASC) to complement and co-ordinate the logistics capabilities of co-operating humanitarian agencies during large-scale complex emergencies and natural disasters. The UNJLC defines and implements the UN SDI-T which constitutes the transport-related branch of the United Nations Spatial Data Infrastructure (UNSDI).

For planning the humanitarian operations of the UN the information about the actual condition of the streets is very important, as well as up-to-date information about hindrances and danger areas. Based on the OpenRouteService.org (ORS) platform we developed a special Web portal for supporting the disaster logistics of the UN. While ORS uses data from OpenStreetMap in this special portal the data from SDI-T was deployed. This data needed special processing in order to make it usable for routing in the first place. Currently the portal was realized for whole of Africa. An important feature of ORS for the disaster management operation was to consider blocked areas or streets when routing. The OGC standard implemented in ORS, the Open Location Services Route Service, defines so called "AvoidAreas", which can be used to realize such a functionality. The portal allows UN staff to define and upload spatial data that represent those AvoidAreas into a geo database though the Web using the WFS-T (OGC Web

Feature Service Transactional). Further OGC services include a WMS or the OpenLS geocoder. This portal is a follow-up of a first prototype that was actually used during the UN emergency operation in Haiti after hurricane Ike killed over a hundred people and left tens of thousands homeless. Based on those real experiences the UNJLC planned to set up a portal to support in future operations. Some extensions include the handling of different types of vehicles and different, even temporary - conditions of the roads. For example a non paved road my become muddy after heavy rain and may only be accessible by All-Wheel Drives of a certain type. Another example is that even after flooding some specialized vehicles may still be able to pass the road if the flooding does not exceed a certain height. This means that is necessary to be able to add further metadata attributes to the AvoidAreas and specific combinations of those need to be considered for different types of vehicles from bikes to heavy trucks with/without trailers when routing. The service is provided though our group, the usage of the UN data within the pilot needs to be clarified if the data is needed.

Haiti Routing (January 2010)

How free geo data and OGC web service can support humanitarian help in crisis situations was demonstrated by developing a route service within the region of Haiti. In January 2010 Haiti was afflicted by an enormous earthquake. Large parts of the infrastructure get destroyed by the disaster. Only little time after the earthquake, the OpenStreetMap community has startet to support local rescue and technical help teams by creating geo data for Haiti. Since then geographic data from Haiti especially from the capital Port au Prince explodes. For this special case several organizations and companies have been providing actual satellite scenes of the affected regions. That motivates the community to map not only regular geo data but also to map changes like destroyed streets that cannot be passed by rescue vehicles. Figure 2 shows a screenshot of the OpenRouteService-Haiti portal. Note the red marked avoid area and the blue line which represents the route between two spots considering the avoid area.

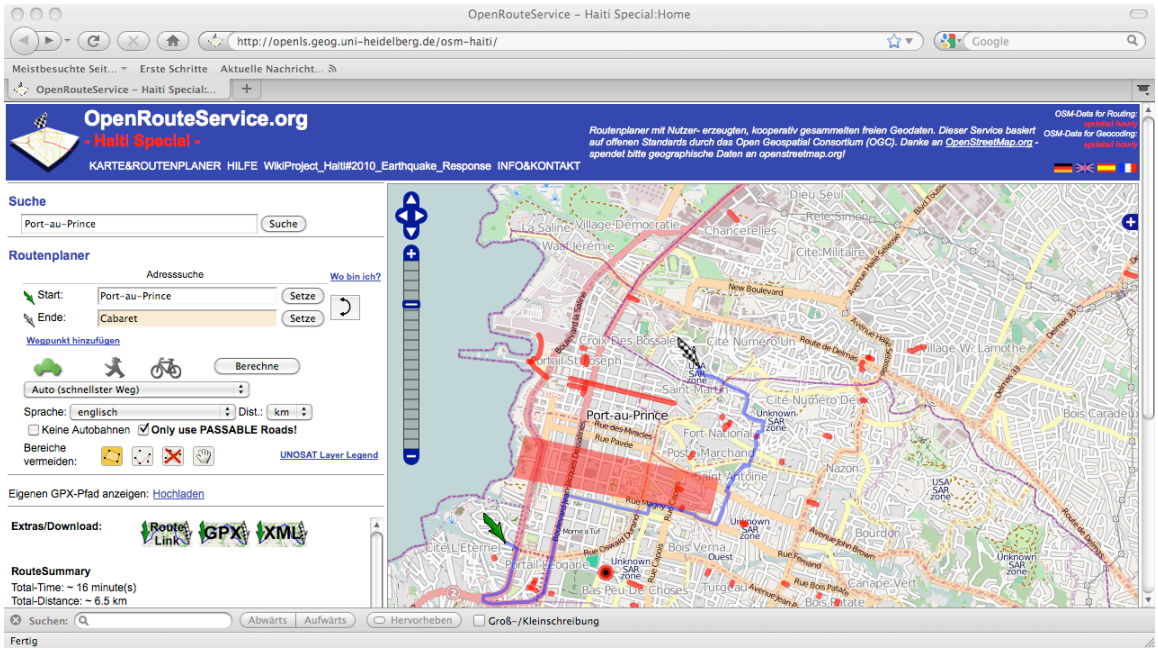

Figure 1: Screenshot of the OpenRouteService portal Haiti

We decided to set up a route service for this region that is being updates every hour with the lastest dstreet network data that has been derived mostly from satellite imagery to provide actual routing data for the affected region (http://openls.geog.uni-heidelberg.de/osm-haiti/).

Web 3D Service (W3DS)

The purpose of the W3DS is to support interactive 3D web applications such as virtual fly-throughs, virtual globes, and information systems on the web showing landscape and city models. The features of the formats being used enable to add more realism to sceneries by applying textures, complex materials, animations, levels-of-detail (LODs), lights, sounds, or other visual effects. The content can be integrated into existing applications or it can be combined with local data allowing realizing real GIS analysis and complex workflows with high interactivity. Data from several servers can be integrated into one complex scene.

The W3DS can be used in two ways. One way is to generate a complete 3D map with all the geospatial content that is required by a specific application and a spatial extent that can be freely defined. This map can be shown and explored in a browser or other off-the-shelf viewer software and easily linked with web portals since the map can be defined by a single hyperlink. Additional predefined viewpoints and navigation modes may be used to guide the user. The second way is to use the W3DS as a streaming server and download all geospatial content tile-by-tile and layer-by-layer. It could be already shown that huge data sets covering whole states with millions of buildings can be visualized (www.osm-3D.org, www.NRW-3D.de) using the experimental XNavigator client, which

implements a block based streaming schema. Figure 2 shows a screenshot of the presentation of 3D that has been served by a W3DS and embedded by the XNavigator client. This figure shows no satellite imagery as we have no access to relevant data sets for this region, but the service is capable of serving textured DEMs, as has been realized in the case of www.heidelberg-3d.de (Figure 3) showing 10cm aerial images together with official surveying data from the municipality. Currently we offer a W3DS service that provides a 3D landscape and city model for all of Germany and the regions south of Germany reaching till to the Adria.

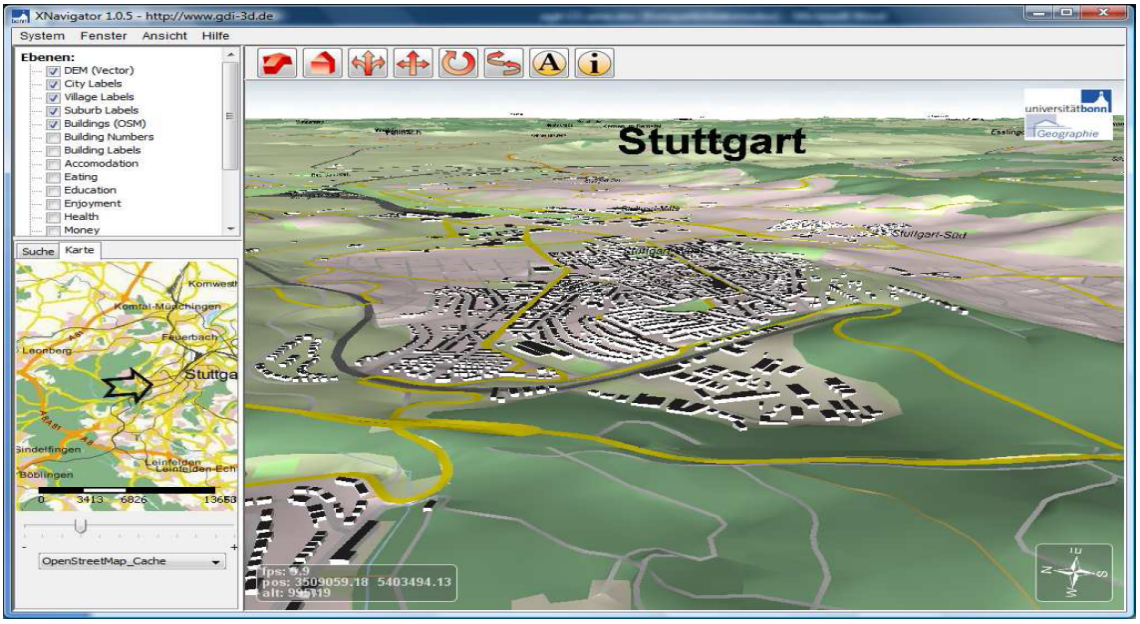

Figure 2: Presentation of 3D data that has been served by a W3DS (www.osm-3d.org)

Figure 3: Presentation of 3D data that has been served by a W3DS (www.heidelberg-3d.de)

The W3DS, now available in version 0.4, is built around 3D web formats that are widely adopted by the industry, especially X3D, KML/KMZ and Collada. Unlike GML, these formats focus on the visual appearance and performance of 3D models, exploiting the capabilities of modern graphics hardware. Also the size and memory footprint is generally smaller compared to GML, which makes them suitable for the distribution in limited bandwidth networks.

Other features of the W3DS include explicit support of multiple LODs, server styles (for instance a layer may be available as default style, showing all object in their original appearance, and alternative style which modifies all colors based on available attribute data), and a temporal component (access to historic models).

A reference implementation is being developed at the University of Heidelberg, GIScience Research Group, headed by Prof. Alexander Zipf. (See link below)

3D Symbology Encoding (3D SE)

Already in the previous OGC TC Meeting an extension of the well-known Symbology Encoding (originally developed as Styled Layer Descriptor, SLD for the WMS specification) has been published as a public discussion draft. The extension realizes a 3D profile of the Symbology Encoding. This profile can be used in combination of the both services mentioned above. For the W3DS there exists already a first implementation within the project GDI-3D.de.

3D SE is compatible with the conventional Symbology Encoding offering all options for visualizing 2D geometries, text and also thematical, geometric and topological selections based on the OGC Filter Encoding. In addition to the styles offered by the service directly (Server Styles) it is also possible for the user (or client) to specify a style on the fly (User Styles). This allows to integrate 3d scenes from different W3DS services and visualize those in an uniform way. Also thematic classifications can be realized. Additional extensions of 3D SE deal with the placement, transformation and rotation of objects in all three axes, symbolizer for analytical styling of DEMs, integration of external 3D objects in the scene or the definition of complex materials and other options.

The 3D SE discussion draft has also been developed at the Chair of Geoinformatics, Prof. Zipf, University of Heidelberg and is already being used in a productive environment at the city administration of the city of Heidelberg.

2.3 Architecture and Interoperability Arrangement Development

OpenLS RouteService

The route service implements the routing functionality after OGC OpenLS specification (http://www.opengeospatial.org/standards/ols). Because of that the interfaces are defined within the specification documents of the OGC and everyone can easy integrate the service in his software components.

To request the route service, the client should build a XML request document and send it via http-post to the route service servlet. The servlet calculates the desired route and sends it back within the response XML document.

W3DS

The W3DS requires a medium client architecture that hast the possibility to render 3D scenes. As other OGC services the W3DS implements following operations:

a) GetCapabilities – This operation allows a client to request and receive back service metadata (or Capabilities) documents that describe the abilities of the specific server implementation. This operation also supports negotiation of the standard version being used for client-server interactions.

b) GetScene – This operation allows a client to retrieve 3D Scenes.

c) GetFeatureInfo – This operation allows a client to retrieve attribute data of selected features.

d) GetLayerInfo – This operation allows a client to retrieve information on available attribute names and values of a selected layer.

e) GetTile – This operation allows a client to retrieve single tiles using indices.

The response of the service is a 3D scene coded in VRML or X3D format.

Further information can be found within the W3DS proposal document on http://www.w3ds.org.

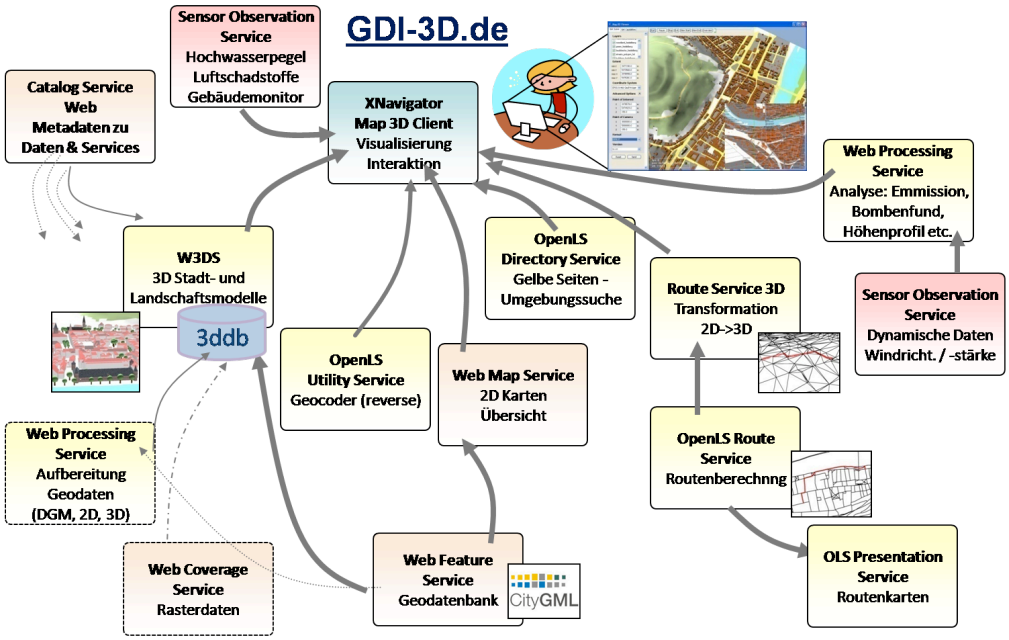

Figure 4: Service Integration of W3DS and OpenLS

3 Description of Responding Organization

The focus of the Chair of GIScience (Geoinformatics) is the investigation and development of new web-based geographic Information Services (GIS). These extend conventional spatial data infrastructures (SDI) by adding the third dimension (3D city models and 3D landscape models, GDI-3D.de), location based services (LBS, in particular specialized applications in routing- , navigation and traffic management), dynamic sensor data and of course web-based geoprocessing and geographic analysis functions (realized as OpenGIS Web Processing Service profiles, OpenGeoprocessing.org). Recent developments in the Web 2.0 such as user generated geodata of OpenStreetMap are being investigated with respect to data quality and usage potential.

Selected services can be used online (e.g. OpenRouteService.org, OSM-3D.de, OSM-WMS.de, RollstuhlRouting.de etc.). This combination of new kinds of data and services lead to SDI 2.0. The usability of these geoinformation services and map applications and their cognitive fundamentals are being investigated empirically (Map Usability).

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