Putting GDI-3D into practice: Experiences from developing an 3D spatial data infrastructure based on OpenGIS standards for the sustainable management of urban areas

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SUMMARY

When someone wanted to publish 3D-city models on the internet, until recently there were only some proprietary digital globes or special solutions of a few companies available. But as the success of the OpenGIS WMS demonstrates, distributed solutions based on standardized web services provide an attractive alternative. The system described here tries to achieve this. The benefit of transmitting real 3D scenes instead of only pictures is evident (also known from typical virtual globes), as the 3D city models can be experienced interactively and also enriched with further information and applications when you actually need to work with the data. For example with such a solution data providers can integrate their own highly detailed digital elevation models.

The main goal of the project GDI-3D (geo-spatial data infrastructure 3D) is to built and evaluate a complete 3D spatial data infrastructure (3D-SDI) based on OGC services. Such service oriented architectures (SOA) gain importance also for GI applications and in urban management. GDI-3D implements for the first time a whole set of relevant OpenGIS services and integrates those into a comprehensive web-based 3D application for an urban area. The fist testcase is the City of Heidelberg, Germany, but a range of other cities have shown interest and we have tested the system for much larger areas.

The core of the system GDI-3D.de is one of the first implementations of the OpenGIS Web 3D Service (OGC W3DS) discussion paper. Within the OGC 3D Information Management (3DIM) working group a subgroup works on extending this towards becoming an OGC implementation specification together with some other aspects of 3D Portrayal. Our system comes with a free 3D-client called <XNavigator>. This client is a Java WebStart-Application and will be installed automatically if you follow the respective URL and if Java 6 is already installed on the computer. XNavigator allows exploring and analysing the 3D city and landscaping models which are streamed by the W3DS server. A range of applications have been integrated in order to let the user work with the 3d model. In contrast to conventional proprietary 3D GIS the whole system is totally based on standards of the Open Geospatial Consortium (OGC). This ensures a maximum of flexibility of the architecture as you can insert or exchange standardized components realized as web services from arbitrary vendors quite easily. The system consists of the following OGC services which have either been implemented within the project or our research group (e.g. the OpenLS services) or are available as open source (such as WMS, WFS):

- The ***W3DS (Web 3D Service)*** itself as 3D portrayal service. It has its own 3D database and tools for generating optimized 3D models from raw data, including CityGML as import.

- ***OpenLS Route Service*** (3D-Routing with height profile & animation – routes also over bridges

- Geocoder of the OGC ***OpenLS Utility Service*** (adress search and vice versa).

- ***OpenGIS Web Processing Service (WPS)*** . There are several WPS processes involved: for preprocessing of the geodata, as well as special analysis functions. Among others one WPS process also uses the

- ***OpenGIS Sensor Observation Service (SOS)*** for near real timeinformation from sensors (gauge levels, weather etc.).

- ***OpenLS Directory Service,*** performs spatial queries for Points of Interest (POIs) and display them in 3D within our W3DS-Client XNavigator. The POIs have been imported from the OpenStreetMap data. They contain a variety of important and interesting locations like shops, ATMs, cafes, pharmacies, bus stops, hotels, night clubs, and many more. Currently over 50 categories are available within our service. The possible categories are unlimited and the data is being extended rapidly. The user can click on the 3D scene and search for specific types of locations within a selected radius. The result is shown as 3D labels.

- Of course the system also includes the well known base components for SDIs, such as the

  **** Web Map Service (WMS), (overview map)***

  **** Web Feature Service (WFS) (e.g. CityGML)***

  **** Catalogue Service (CS-W).***

Only shortly after CityGML became an official OGC standard it was also supported as import format for the GDI-3D technology. The CityGML data is being processed into an optimized 3D visualization format and stored in a special 3D geodatabase for efficient web-based visualization through streaming

Further components will be added as the project proceeds (e.g. specialized WPS processes and other Sensor Web services).

A special feature of the system is that the appearance of the 3D visualization can be controlled from the client through the ***OGC Symbology Encoding Specification***. Similar to the well known WMS Styled Layer Descriptor (SLD) this approach allows realizing thematic cartography in 3D. One usage is to harmonize the look of data that comes from different server in one scene. An integrated SLD-editor allows doing this by the user on the fly. A range of visualization styles are already offered by the server.

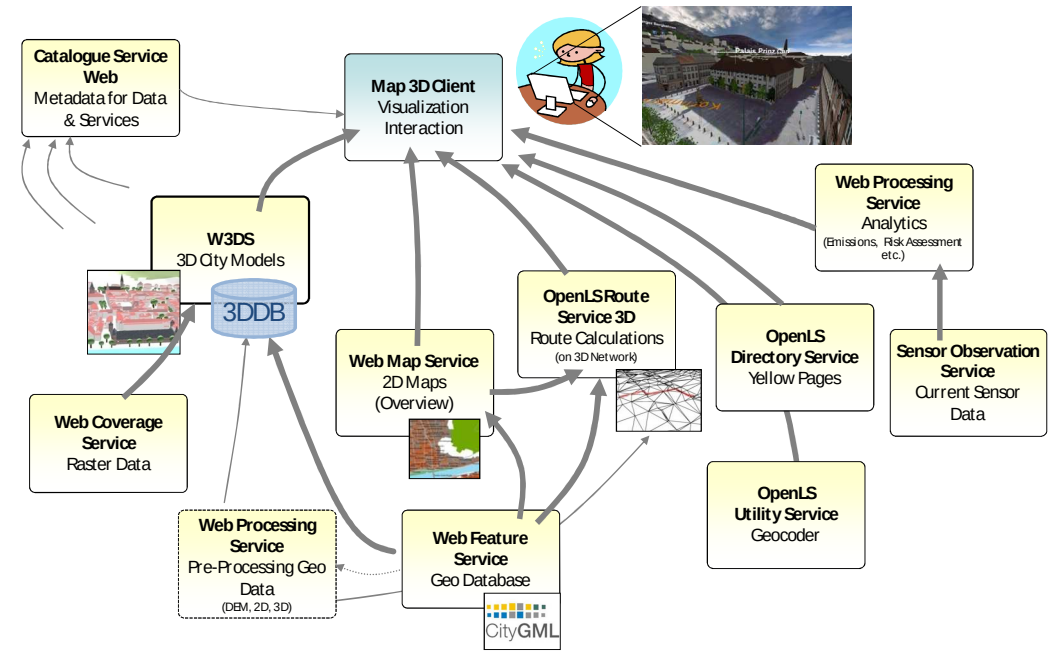
The 3D model has been generated in very close cooperation with the surveying office of the city of Heidelberg. Further content stems from other partners or has been digitized within the project itself. Most of the data has been generated from 2D data automatically. The system includes the complete set of buildings of the city of Heidelberg (~40.000) that can be accessed from the web. Further it features a 5 meter-DEM, landuse, airborne photographs, street names and a range of other data such as historic flood areas, parking lots, laterns, street and traffic signs, trees and even a detailed model of the Virgin Mary that has been generated from terrestrial laser scan. A increasing set of important buildings and bridges have been modeled in higher detail and have textures. All data is preprocessed for efficient streaming and managed within a geodatabase.

The goal of the project, that is funded by the Klaus-Tschira-Foundation in Heidelberg, is to develop new technologies and standards for the interoperable processing, visualization and analysis of 3D city and landscape models. The first version of the system will be developed further and has also already been tested successfully with 3D models of other cities.

Further information, videos, screenshots, publications and the link for starting the actual online system can be found at:

www.gdi-3d.de /_www.heidelberg-3d.de

Figures


Catalogue Service Web
Metadata for Data & Services
Map 3D Client
Visualization Interaction
Web Processing Service
Analytics
(Emissions, Risk Assessment etc.)
W3DS
3D City Models
3DDB
OpenLS Route Service 3D
Route Calculations
(on 3D Network)
OpenLS Directory Service
Yellow Pages
Sensor Observation Service
Current Sensor Data
Web Map Service
2D Maps
(Overview)
Web Coverage Service
Raster Data
OpenLS Utility Service
Geocoder
Web Processing Service
Pre-Processing Geo Data
(DEM, 2D, 3D)
Web Feature Service
Geo Database
CityGML


Montpellier-Platz


XNavigator
System
Views
Help
Layers
Halteste llen
integrated_DEM
Gebaeude_LOD1
Gebaeude_LOD2
Denkmaeler
Baeume
streetlabels
Map
Bomb Threat
Styles
Routing
Lighting
default
UserStyle
Kartographisch
UseStyle
Verkehrszeichen
POIs
Hochwasser
Ok
Cancel
Loading...


XNavigator - http://www.gdi-3d.de
System
Panels
View
Help
LOD2
LOD1
LOD1|2
fokus_50_150_250
Cartographic_LOD1
Monuments
Trees
Styles:
default
FirTree
PlantBillboard
LOD
Complex
Abstract
Search
Routing
Map
Lighting
Heidelberg Aerial Imagery
fps: 10.6
pos: 3477764.43 5475007.95
alt: 152.14

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Personal Information:

Prof. Dr. Alexander Zipf holds the Chair of Cartography at the Department of Geography at the University of Bonn. Before that he was Professor for Applied Computer Science and Geoinformatics at the Department of Geoinformatics and Surveying at the University of Applied Sciences FH Mainz. He did his PhD at the private research institute "European Media Laboratory" (EML) in Heidelberg in his project "Deep Map" after studying mathematics and geography at the University of Heidelberg, Germany. His research interests include a broad range of aspects of Geoinformatics, GIScience and Cartography from LBS to Web2.0, 3D SDI and ubiquitous GI services.

Arne Schilling and Stefan Neubauer work in the research group of Alexander Zipf.

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