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The Dutch National Atlas in a Service-Oriented Architecture

Barend Köbben

ITC – University of Twente, Faculty of Geo-Information Science and Earth Observation, Enschede, The Netherlands, kobben@itc.nl

Abstract

In this paper we describe the National Atlas of the Netherlands map viewer, that visualizes data from the Dutch National GeoData Infrastructure, and that is based on combining a Service-Oriented Architecture with the Open Web Platform.

The objective was to investigate how the national atlas could be organised as an integral part of the spatial data infrastructure (SDI). Such an atlas would benefit from up-to-date data flow, and the SDI would benefit from integrated visual summaries of available spatial data and geoservices in well-designed comparable maps. As such a national atlas provides alternative interactive and dynamic ways to access the SDI.

The map viewer part of the current prototype is based on the Open Web Platform, enabling a browser-based client without the need for proprietary technology. We used the D3 Javascript API, which allows one to bind arbitrary data to web visualizations.

In the paper, we describe the set–up of the National Atlas prototype. We also look forward, by describing what further work is needed to fully implement the concept of a National Atlas in a SOA-based environment.

Keywords: National Atlas, Service Oriented Architecture, Web-based cartography, Open Web Platform.

Biography

Barend Köbben holds an MSc in Geography, specialising in Cartography, from Utrecht University in The Netherlands. He currently works at ITC, the Faculty of Geo-information Sciences and Earth Observation of the University of Twente. Here he is at present Senior Lecturer in GIS and cartographic visualisation. His teaching subjects include web cartography, geo-webservices, and web application building. He is promoting the use of the Open Source geospatial applications and data by organizing workshops world-wide. His main research interests are automated mapping in a services environment and animated vector map services, using his Open Source RIMapper WMS platform.

1 Introduction

In the Netherlands, a second, and last official, edition of the National Atlas was published by the Foundation for the Scientific Atlas of the Netherlands in the years 1989–1995 (Smidt,

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M. de, et al. 1995). It was a series of printed booklets, centered on the inhabitants of the country and dealing with many aspects of the sciences (socio-economic, climate, geology, soil, etcetera) . The series was authored by a government-sponsored Atlas Bureau, based at the national mapping agency. Unfortunately, the government support ended and this left a penniless foundation, with the copyright to its two national atlas editions as its only asset. The foundation endeavored to keep the national atlas concept alive by making scanned versions of all maps from the previous two printed editions available on a website (*Dutch National Atlas website* 2012).

National atlases are still made as printed products, but nowadays increasingly in digital mass-consumer environments. As the World Wide Web become popular, cartographers soon started experimenting, as early tests for an online Dutch National Atlas demonstrate (Köbben & Koop 1997). Until recently, most digital atlases were produced using digital, but still traditional, tools: graphic design software and stand–alone visualisation toolkits. And even though these result in products that can be of excellent quality and usability *in* themselves, they are also *on* themselves: They lack the interoperability and connections with the wider digital world outside that we come to expect in this age of Spatial Data Infrastructures (SDIs).

The recent development and success of such an SDI in the Netherlands, the 'Nationale GeoData Infrastructuur' (NGDI), has also rekindled interest in the national atlas. With its broad scope, many datasets not originally meant for combining, and users with quite different needs, the NGDI poses many challenges for any implementation that needs a close integration of its component pieces, such as a National Atlas. A GDI in itself, although it will allow mapping the different data sets, does not constitute an atlas, because the maps are often incompatible. It thus will not constitute more then the sum of its parts, as a good atlas would.

To tackle this problem, a study (described in detail in Kraak et al. 2009) was conducted to investigate the feasibility of using Service Oriented Architecture (SOA) technology to guarantee an up-to-date, cartographically sound, national atlas. The objective was to organize a national atlas as an integral part of the NGDI, and to build a proof–of–concept prototype. Such an atlas would benefit from the up-to-date data in the SDI, and the SDI would benefit from having integrated visual summaries of the available spatial data, in well-designed, comparable maps. As such a national atlas would provide an alternative, interactive and dynamic, way to access the SDI (Kraak et al. 2009).

The study was funded by a research grant that ended in 2009. Since then, we have been continuing the development of the National Atlas prototype as an informal project to be worked on if time permits, and the progress is therefore slow and limited in scope.

The results we present in this paper are firstly a revised set–up of the overall architecture (in section 3, after a brief introduction of some underlying concepts in section 2). In this set–up, we introduced a National Atlas Services layer to connect the NGDI with the National Atlas map viewer. Secondly, in section 4 we describe how we have revised the Atlas Map Viewer to work on the modern Open Web Platform. We finish with a conclusion on results thusfar and an outlook into the future developments, in section 5.

2 Mapping in a Service Oriented Architecture environment

A Service-Oriented Architecture (SOA) differs from traditional software setups in that the distributed components fully encapsulate their own functionalities and make them accessible via well specified and standardised interfaces. There are many ways of setting up

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such SOA's, but by far the most used platform is the World Wide Web and the SOA's implemented on the web are usually called webservices (Peng & Tsou 2003).

The principle of disseminating maps in a webservices environment is depicted in Figure 1. This general set–up is being used in many of today's webmapping efforts, with considerable variation in the choice of technology for the mapping service and the subsequent map formats. This choice to a large extent defines the possibilities of the system as a whole to achieve what we call the *direct* and *automatic* production of maps.

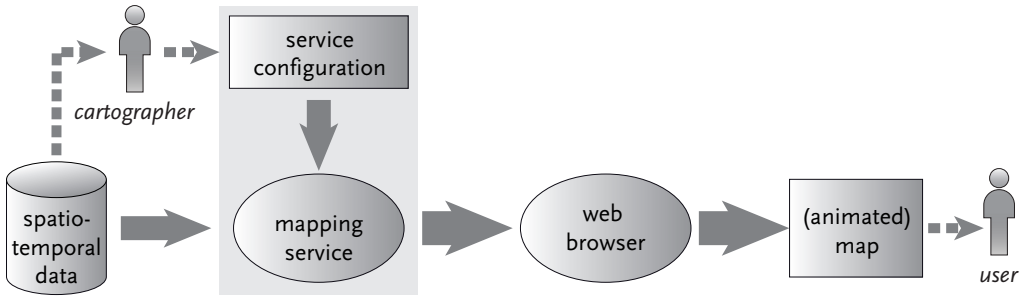

Fig. 1. General principle of dissemination of maps in a Service Oriented Architecture (from Köbben et al. 2012).

By 'direct' we mean that the maps are generated on-the-fly from the data. This is necessary because the map generation should fit in an interoperable SDI, and it guarantees the maps are always up-to-date. To achieve this directness, the visualization functionality should be loosely coupled to the other parts of the system. The Open Geospatial Consortium's (OGC) Open Web Services (OWS) and related specifications (OGC 2010) are especially useful for this. These webservices are designed to take their input from a variety of distributed sources and generate output meant for Internet dissemination.

We consider 'automatic' to mean that the maps will be generated from the data by the system "working by itself with little or no direct human control" (which is how automatic is defined in Fowler et al. 1976). It is important to note that this automation in most current systems does not include the cartographic decisions as to what type of map to use for different data–types and data–instances. The link between data- and visualisation-type has to be made by a human (the cartographer in Figure 1), setting up the appropriate service configuration.

3 Architectural set–up of the Dutch National Atlas

In an SDI such as the Dutch NGDI, many of such services come together. As we noticed is section 1, this poses challenges if we want to combine them in cartographically sound maps. In many existing webmapping set–ups the maps are delivered to the end-user as raster images from Web Map Services. Although such map layers can technically be combined in a compound map, this is not a desirable solution for an atlas system, as the portrayals of the layers can not be influenced, and therefore can not be matched. For that reason, the National Atlas uses *data* services instead of *portrayal* services. As can be seen in the proposed set–up in Figure 2, we consume data from Web Feature Services (WFS), and combine and portray that data using a client–side data integration and mapping component (described in more detail in section 4).

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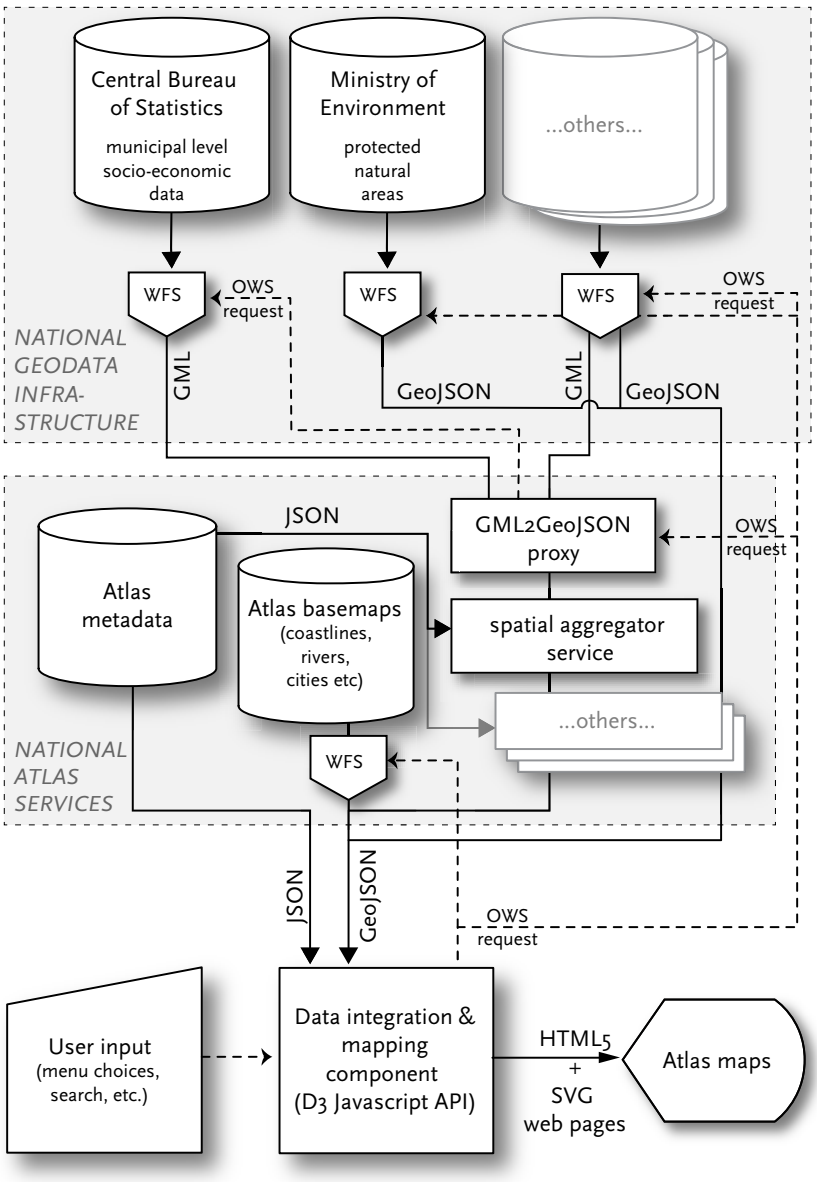

Fig. 2. Proposed set–up of combining the SOA-environment of the NGDI with the National Atlas services and the National Atlas map viewer on the Open Web Platform.

In the earlier prototype of 2009, the client–side mapping application directly consumed the WFS output, in most cases a Geography Markup Language (GML) data stream. It also included a set of atlas metadata: design templates, classification schemes and the other components needed to set the service configuration mentioned earlier in section 2.

This approach had several drawbacks. GML is a versatile and powerful language, but also a complicated one. At the time (for various reasons described in Kraak et al. 2009), we used our own limited set of services. Therefore, it was feasible to have the client-side component parsing the GML data. However, in the current implementation we can and want to

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use a very wide range of existing data services, and therefore can expect GML data of different versions and with a large variation in GML application schemata. We decided not to try parsing this client–side, but instead feed the mapping component with GeoJSON data. This geographic extension of the JavaScript Object Notation format (see *GeoJSON website* 2012) is light-weight and optimized for use in client-side web applications. Although some services in the NGDI do actually supply data in GeoJSON format, most only support GML output. We therefore introduced in our set–up a conversion component in an intermediate National Atlas Services layer, depicted as the GML2GeoJSON proxy in Figure 2.

Another component in the National Atlas Services layer is the Atlas base map service. This serves data for several map layers that are used repeatedly, such as coastlines and major cities. This enables us to provide a common look and feel to the maps. We foresee the implementation of more atlas services, such as a spatial aggregator service, that for example would perform the generalization of socio-economic data at the municipal level into higher level provincial data.

This same National Atlas Services layer now also includes the atlas metadata mentioned before. This makes it possible to loosely couple the metadata with the mapping component, as opposed to the tight coupling in the earlier prototype. It also makes the atlas metadata available for a wider audience.

The National GeoData Infrastructure layer includes of course a broad range of possible data services. The two services specifically mentioned in Figure 2 are the only ones we use in the prototype at the time of writing. Which services are actually used by the atlas is determined by the settings in the Atlas metadata. For reasons elaborated in section 2, many of these settings have to be edited "by hand". This is the main reason the National Atlas cannot do without some kind of light weight editing staff. They are responsible for the cartographic quality of the atlas, and for example should also keep tabs on both the new geospatial information being made available by national providers as well as taking account of the changing needs and interests of the general public, schools and professionals (Kraak et al. 2009).

4 Using the Open Web Platform for the atlas viewer prototype

The map viewer part of the earlier prototype was pragmatically based on existing components, and therefore implemented using the proprietary Adobe Flash technology.

Following the current development of the Web, a logical next step was a map viewer component based on the *Open Web Platform*. The primary goal of the the Open Web Platform, an initiative of the World Wide Web Consortium (W3C) is to create a comprehensive range of advanced, open standards (W3C 2012), enabling us to create web applications without the need for proprietary technology.

We tested various possible set–ups of the map viewer component, and based on these tests decided to use the D3 library (Bostock et al. 2011, *D3 website* 2012). D3.js is a JavaScript library for manipulating web pages programmatically, through their Document Object Model (DOM). It allows you to bind arbitrary data to the DOM, and then apply data-driven transformations to it, using the full capabilities of modern web standards such as CSS3, HTML5 and SVG.

We found D3 to be fast and efficient, even when using large datasets. Its code structure, based on the popular Javascript framework jQuery, allows for dynamic behaviours for interaction and animation.

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The resulting map viewer offers high-quality interactive map views of data from the NGDI. The viewers latest incarnation can be tried out at the website (*Dutch National Atlas website* 2012), a screen dump is provided in Figure 3.

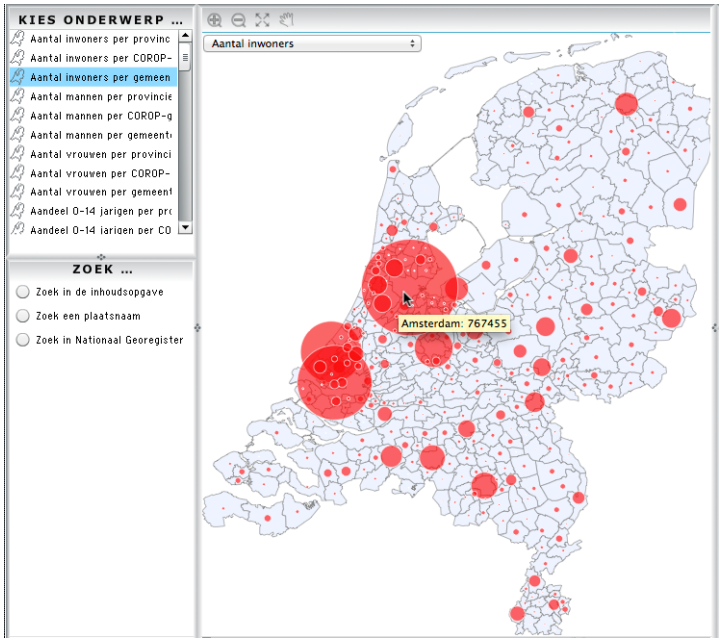

Fig. 3. A screendump of output of the National Atlas viewer prototype. The D3 library was used to interactively map the number of inhabitants per municipality (from Central Bureau of Statistics Web Feature Services) as a proportional point symbol map, using HTML5 and SVG.

5 Conclusion and outlook

As mentioned earlier, development of the Dutch National Atlas in the Service-Oriented Architecture is at the moment slow–moving and limited in scope. We feel however, that the current set–up and proof-of-concept prototype, as described in this paper, allows us to show that high-quality atlas mapping using services from a national SDI is feasible, and provides many advantages in up-to-dateness, interoperability and adherence to standards, flexibility and extensibility.

We hope to further enhance the system, and gradually extend the amount of data mapped. Furthermore, we also consider the National Atlas in the NGDI as an excellent testing ground for more fundamental cartographic research questions. Specifically the further automation of setting service configuration parameters, with cartographic design decisions included (mentioned in section 2) remains an interesting research challenge that we hope to work on in the future.

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