WHAT HAPPENS AT 52N?
AN OPEN SOURCE APPROACH TO EDUCATION AND RESEARCH

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Abstract: *In late 2004, the free and open source software initiative 52°North (http://www.52north.org) has been founded by the Institute for Geoinformatics at the University of Muenster and con terra GmbH in order to face the aforementioned challenge. The International Institute for Geo-Information Science and Earth Observation (ITC) in Enschede (The Netherlands) has joined 52°North as a principal partner at the beginning of 2005. This conjoint initiative aims at developing free and open source software for the acquisition, analysis and visualization of geospatial data within open Geospatial Data Infrastructures. From an educational perspective Enschede put emphasis on introducing the open source software in its GeoInformatics master and Muenster puts its main focus on Sensor Web Enablement and Web Service Security research.*

BACKGROUND

While browsing your atlas you find two interesting locations at latitude 52º North: Münster and Enschede. The latitude of those two towns has been chosen as the name for a free and open source software initiative: 52º North (www.52north.org). It was founded by the Institute for Geoinformatics at the University of Münster and con terra GmbH in 2004. The International Institute for Geo-Information Science and Earth Observation (ITC) in Enschede (The Netherlands) has joined as a full member at the beginning of 2005. This conjoint initiative aims at developing free and open source software for the acquisition, analysis and visualization of geospatial data within open Geospatial Data Infrastructures. The widest possible dissemination and popularization of the already developed software in the market for geospatial information technologies (public and private users, research and education bodies, developer communities, commercial entities etc.) is assured by releasing it under the terms of the GNU General Public License.

Modern geospatial information and communication technology shall foster human decision making by ensuring a seamless access to usable geospatial data and geoprocessing resources. Today, one of the challenges in the international geospatial information community is the development and deployment of distributed technology arrangements that provide means for accessing, exploring, and utilizing the aforementioned resources over a pervasive communication network like the Internet – anywhere, anytime, and with any device. A purposeful step in this direction is the establishment of Geospatial Data Infrastructures, a process that gains a respectable momentum worldwide nowadays. Concurrently, research bodies and the software industry explore a new software business model that proves beneficial for both the software user and the respective provider. Free and open source software development cannot anymore be exclusively associated with non-commercial, independent developer communities. It also represents an economically viable model for the software industry. These two orthogonal trends establish a tremendous challenge in geoinformatics. However, it remains unexplored at present with regard to its technological and commercial potential.

Moreover, the research and software development activities shall be tailored to come along with technical innovations and user oriented software releases. 52°North fosters a collaborative, peer reviewed, step by step software development that is at the heart of prospective application domains. Quality management is thereby of paramount importance as it helps to keep track on software usability and continuity. At the same time, the initiative is about to fuel national and international standardization efforts being relevant for the software in scope; most notably those governed by the Open Geospatial Consortium (OGC). Based on the already existing network of excellence for geospatial information technologies, which spans across science and industry, 52°North's mission is to advance the design, development and use of free and open source software in geoinformatics research, training and application. It envisions to bridging the gap between open source and proprietary solutions.

ITC has joined this initiative for several reasons. Most important is the educational perspective. Since ITC is a global player on the educational market oriented for education in geoinformation science and earth observation in the lesser developed countries the opportunity to be able to use free software is very appealing especially for our Joint Educational Programs and all types of distance and blended education. However, open source is free but has its price. Once I heard someone explaining this as: 'Free' as in 'freedom' and not as in 'free beer'. Some of our customers can not always afford mainstream GIS software and the open source approach could be an alternative. Although on has to realize that, currently, open source software is no full fledges alternative for a package like ArcGIS. From a research perspective 52N provides a common development platform for almost all software related research activities. As such it will become an integral part of all collaborative research activities within the Institute and between ITC and external partners and as such ensure sustainability and maintainability of research results. Since our PhD-students benefit from others publishing their result it is no more then logic we follow a similar approach.

MANAGEMENT

The software development process of 52°North requires a vital management that establishes a normative framework for the ongoing and future software development and assures software quality and continuity. Figure 1 mirrors the organizational model of this initiative. The software development takes place in Working Groups, Projects, and Task Forces. Representatives from these operational units establish two superordinated units, i.e. Steering Committee and Technical Committee. Both units decide by consensus about resolutions and activities. While the former committee is responsible for the coordination of strategic issues of 52°North, the latter committee coordinates all work with relation to the underlying framework architecture model. The back office activities (i.a. marketing, quality management, international affairs) of 52°North are organized within the Executive Board. Certain members of this unit are also represented in the Steering and the Technical Committee. All aforementioned units are obligated to the mission statement and the long term goals defined by the Board of Directors. At present, this board consists of representatives from the three principal partner organizations of 52°North, i.e. Institute for Geoinformatics at the University of Muenster, con terra GmbH, and International Institute for Geo-Information Science and Earth Observation (ITC). Its representatives also populate the Steering Committee.

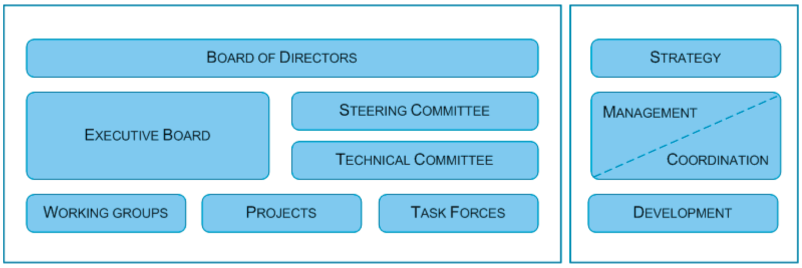

Figure 1: 52°North organization model (while the left box depicts the organization units, the right box generalizes the tasks assigned to these units – see also www.52north.org)

The existing software development units (e.g. Sensor Web Enablement Working Group or Security Working Group) contribute to the building of development and stable releases of software that resides either in the incubator area and/or the core area of 52°North. While the incubator area accommodates prototypical implementations, proof of concepts, and the like in order to explore a wide range of technological opportunities, the core area is focused on the development and maintenance of ready-for-use software that fulfills quality requirements defined by 52°North, and which fully complies with the research and development agenda of the initiative. Upon proposal of a working group or project, development releases may migrate from the incubator to the core area in order to reengineer them into stable releases

DUAL LICENSING MODEL

All source code developed either in the incubator or core area of 52°North, thus no matter whether it is a development or stable release, is published under the terms of GNU GPL v2.0. The stable releases of 52°North, i.e. all software from the core area, are concurrently published under a commercial license. This approach is called dual licensing and requires a copyright assignment from source code contributors or the copyright holders behind them. It does not harm the terms of GNU GPL. From the licensing perspective, the stable releases are thus made available as two different versions, depending on their usage and distribution, though technically the source code is identical. This approach is very much like that one chosen by MySQL AB.

Unsurprisingly, there are costs associated with the management and coordination of the software engineering within the development units of 52°North. This dual licensing model provides the principal partners of 52°North with an urgently needed source of funding to continue the development work. The open source license (GNU GPL v2.0) allows the public to freely copy, distribute, modify and compile all 52°North software (development releases from the incubator area as well as stable releases from the core area). It also allows third party software to be linked or otherwise used with 52°North software if it is distributed to the public under a GNU GPL compliant open source license. Our commercial license allows anybody to distribute own software that is based on or otherwise uses the stable releases of 52°North software (software from the core area). This licensing option is meant for individuals and legal bodies that do not want to release their software under a GNU GPL compliant open source license.

52°NORTH IN PRACTICE –EDUCATIONAL CASE: ITC GEOINFORMATICS MASTER

Geoinformatics education should be seen in the context of a GDI. In this context different services are networked together and can communicate using agreed upon protocols and messages via specific interfaces. These services can involve data provision (for instance topographic data at a particular scale), but could also include simple or complex geospatial data handling actions. An example of the first is a request to transform a dataset from one projection into another. An example of the second could be getting available road data, request a for generalization operation and finally visualize it according to a particular design template. Users can request for a particular service via a web portal. The services might involve non-geospatial data as well or could be supporting services such as catalogue or security services. To realize the services, standards to guarantee interoperability are important, and the Open Geospatial Consortium (OGC) plays a prominent role to define standards in the context of the GDI. This implies their implementation of protocols of communication, and exchanges data and delivers services in standardized ways. A characteristic list of keywords of this dimension is: web services, protocols, interfaces, standards, metadata.

Due to the above developments ITC's geoinformatics master (GFM3) is being re-engineered. The aim of the course is to "produce" a geoinformatics engineer equipped to operate in the geo-information world. The master graduate will be able to solve design problems making optimal use of operational technology relevant for providing core geo-spatial data. The course treats modern integrated geoinformation production technology, including methods and techniques of geospatial data acquisition, methods and techniques of geoinformation processing, dissemination and visualization. The course graduate will be able to work at a professional level in geoinformation production including the giving of support to the design and set-up of technological components of a spatial data infrastructure. The target students have a position and function to analyze geo-technical problems, design production processes of geospatial data and services, and evaluate performance.

On completion of the course, the geoinformatics engineers must be able to analyze geo-technical problems and design production processes of geospatial data and services for different application fields of geoinformation. But they can also give support to the design of and implement technological GDI components in an organization, evaluate (intermediate) information products, which can be used as building blocks for multi-level GDIs. They can evaluate the performance of production and dissemination processes, and are expected to work in multidisciplinary teams engaged in production projects, which involve spatial data collection, database management and data dissemination. And last but not least they are able to transfer the gained knowledge into their own working environment.

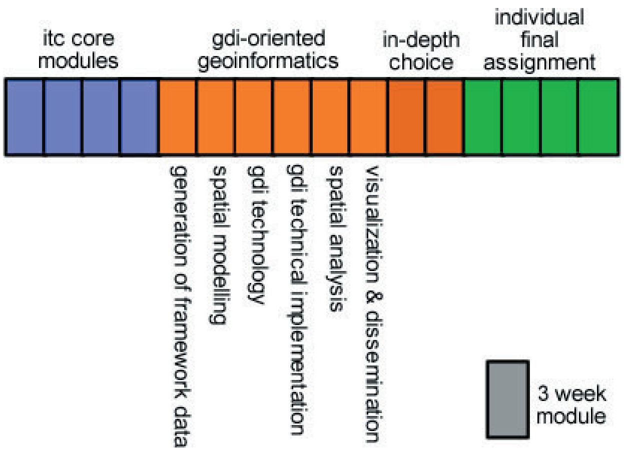

Figure 2: The modular structure of the Geoinformatics master.

As any course at ITC the re-engineered geoinformatics master (GFM3) starts with the core modules. These consist of an introduction to the geoinformatics programme explaining the geoinformatics concept and articulate the role of geospatial data products and services in addressing social and economic development issues, and aspects of good governance. This is followed by a modules on the principles of databases, the principles of GIS, and the principles of remote sensing. These modules should learn the students how to generate information about the Earth from remote sensing and data stored in Geographic Information Systems. This takes the first twelve weeks of the program (see figure 2). The second part of the new stream contains six modules that from a technical point of view all deal with the geospatial data infrastructure. The modules are related to the generation of framework data, spatial modeling, GDI technical design, GDI technical implementation, spatial analysis, and visualization and dissemination of geospatial data. This is followed by two more modules where the students can select topics of their liking to get more in depth knowledge. The topics offered stem from the former specialization Cartography, Photogrammetry and GIS. An Individual Final Assignment will end the program.

The individual modules dealing with the technological aspects of GDI is supported by a case study that practically binds them together and runs through all modules. The case is fully oriented toward the geo-technical aspects of the Geospatial Data Infrastructure. In its approach the guidelines of the Open Geospatial Consortium (http://www.opengeospatial.org/) are followed as much as possible and the students work along open source programming guidelines. This doesn't mean students will no longer work with other existing GIS software – this will certainly be the case, but when building new elements and working on their case study open source is the keyword. Here the objective is to let students create their own open source geospatial data infrastructure and experiment especially with functionality not yet common in mainstream software. But it is not all sunshine. Somehow more skills are expected when compared with of the shelf software. Imagine you access a web portals like Sourceforge (http://sourceforge.net/) where you can download the software you need. However, this is not a trivial business. You have, better then before, to know what you want – something which of course is not bad at all. Suppose you want to plot some maps with GPS tracks you collected. Sourceforge offers many different solutions. Which programme to select? When the descriptions are straightforward it is easy, when not you might experience it by trail and error. Another interesting aspect is that open source software can come as source code only, or as executable. In the fist situation you need to have some programming skills to be able to run it. Still, there are enough arguments to develop new ideas in an open source environment complying with the open geospatial specifications, especially in an academic environment.

52°NORTH IN PRACTICE – RESEARCH CASE: SENSOR WEB ENABLEMENT

Since its foundation 52°North is strongly supporting the OGC Sensor Web Enablement (SWE) Initiative. The SWE Working Group at OGC puts its focus on standard interface specifications and data encodings for GI services that enable the interoperable integration of geosensor data into GDIs. In fact, this group has to tackle problems that still hinder the harvesting and integrative processing of real-time data from such geosensor types like flood gauges and air pollution monitors as well as space and airborne earth imaging devices. Nevertheless, much progress has been achieved so far.

The vision of the SWE advocates is to enable a distributed computation of geosensor data by means of web services. In this context, the trading function (aka publish-find-bind pattern) plays an important role. This function may facilitate the publishing and finding of web services that relate to SWE. While the geosensor data provider publishes its service by storing a service description (metadata) within a registry run by a service broker, the service requestor browses the metadata available in the registry to decide on a suitable service. Once the requestor identified a particular service for use, he can bind his client or another service to it as specified in the technical part of the respective metadata record. At the moment OGC provides three draft service specifications, which form the operational core to set up a web-enabled geosensor network:

Sensor Observation Service

The objective of the Sensor Observation Service (SOS) is to make geosensors and geosensor data archives accessible via an interoperable web based interface. Aside from the GetCapabilities interface that allows requesting a self description of the service and which is typical for each OGC web service, the SOS provides the GetObservation interface to get the pure data (from live geosensors) encoded compliant to the Observation and Measurements (O&M) specification, which is a GML application schema for observation and measurement data. Extending the SOS specification, 52°North specified an ActiveSOS (ASOS) which is enabled to register threshold values conditions for specific observables and sends O&M encoded data in case that the condition is met. Therefore the ASOS provides the SubscribeObservation and the UnsubscribeObservation interfaces. A person who is interested in geosensor data (consumer) signs a contract with the ASOS via the SubscribeObservation operation. The contract (subscription) specifies the conditions for the data supply. The UnsubscribeObservation interface of the ASOS makes it possible to terminate a subscription.

Sensor Planning Service

The Sensor Planning Service (SPS) is intended to provide a standard interface to geosensor data producer devices and to support systems that surrounds them. An SPS not only has to support different kinds of devices with differing capabilities, but also different kinds of request processing systems, which may or may not provide access to the different stages of planning, scheduling, tasking, collection, processing, archiving, and distribution of resulting observation data. The SPS is designed to be flexible enough to handle such a wide variety of configurations.

Web Notification Service

Many uses of SWE services will not require an asynchronous user-service or service-service communication, as all the processing can be handled through purely synchronous exchanges. A Web Notification Service (WNS) executes and manages message dialogue between a client and one or more web service(s) for long-lasting asynchronous processes. The WNS is a general purpose asynchronous and stateful messaging service. It sends well-structured notification content to a client. In order to enable a dialogue between the user and an invoking service, functionality must be provided that enables the user to asynchronously answer with similarly structured content. The communication protocols Email, HTTP POST, short message service (SMS), instant messaging (IM), telephone calls, and faxes are currently supported.

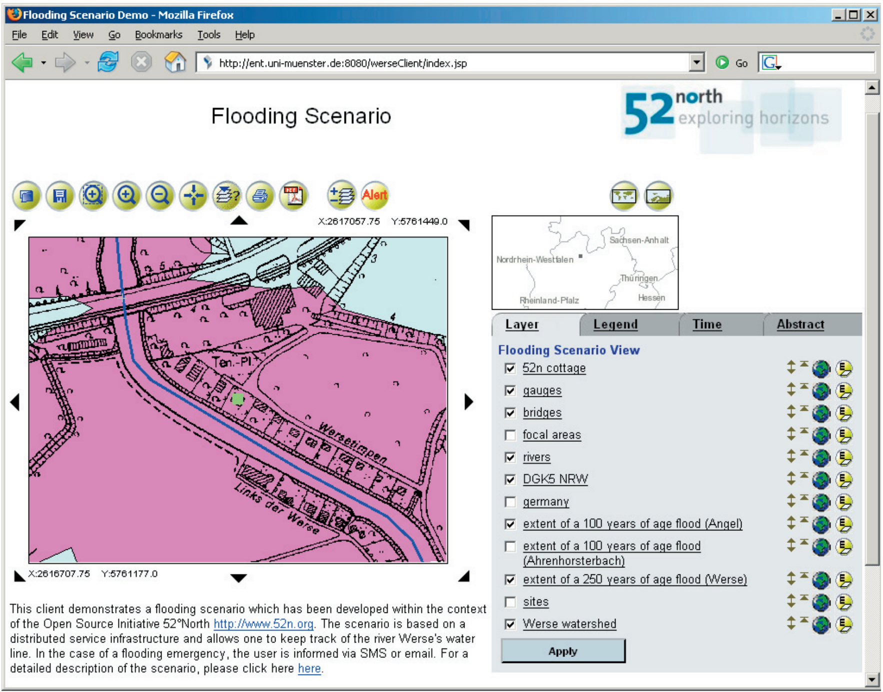

Figure 3: Flooding Scenario Project.

Based on SOS and WNS implementations, both developed by the SWE working group of 52°North, a flooding scenario project was established to demonstrate the functionality and usability of current SWE specifications (http://ent.uni-muenster.de:8080/werseClient/index.jsp). It addresses a real scenario: The Werse, a small river in the Muensterland area, Germany, overflows its banks regularly. This causes major damage to the summer cottages located on either side of the river. The idea is to set up an early warning system based on interoperable SWE services. An SOS is used to access real time water gauge data from four measurement stations along the upper course of the river. The retrieved data is used to calculate the flooding risks for individual summer cottages. To do so, cottage owners have to formulate a monitoring task for a certain location by defining threshold water levels. If the actual water level exceeds this threshold, an alert will be sent via a preconfigured communication channel, either Short Messaging Service (SMS) and/or email, and inform registered cottage owners if it becomes necessary to 'put up the chairs'.

The project demonstrates that the employment of interoperable web services makes floods more manageable, thus reducing hazards for humans and goods. Free and open source software offers those advancements also to those organizations which are not able to afford commercial solutions, like it is often the case in lesser developed countries.