Monitoring of Spatial Data Infrastructures (SDI)

Martin SCHEU and Andreas ROSE, Germany

Key words: Spatial Data Infrastructure (SDI), Monitoring, Reliable Control, Sensors, Tools, Trouble shooting, Protocol Service.

SUMMARY

All over the world, spatial data is considered to be an important component of supporting workflow processes. Spatial data infrastructure (SDI) serve as an use-independent provider of spatial information, spatial data initiatives appear at the regional, national and international level. With regards to the fact that every failure of threaten business operation of third parties SDI availability is of greatest importance. Several aspects of a monitoring strategy are discussed in this paper, e.g. Standards, the types of sensors and tools and their functions as software tools. Multi-level nature of spatial data requires a continuous and reliable control and trouble-shooting. A SDI-Monitoring monitors spatial data infrastructures continuous and in background. The strategy supports trouble-shooting, notifies problems immediately and minimizes failures.

ZUSAMMENFASSUNG

An die Verfügbarkeit von Geodaten-Infrastrukturen werden heute höchste Ansprüche gerichtet, dienen sie doch zur Unterstützung von tagtäglichen Arbeitsprozessen. Systemausfälle sind somit nicht tolerabel, da sie schnell zu signifikanten Störungen in den Arbeitsabläufen führen. Das mehrschichtige Umfeld von Geodaten-Infrastrukturen bedingt eine stetige Kontrolle und Fehlersuche. Werden Fehler nicht rasch genug erkannt und beseitigt, ist die Akzeptanz der Geodaten-Infrastruktur bei den Nutzern in Gefahr.

Die in diesem Beitrag beschriebene Monitoring-Strategie bietet wirksame Unterstützung. Sie überwacht permanent und im Hintergrund Geodaten-Infrastrukturen, meldet Fehlfunktionen sofort und minimiert so Ausfallzeiten. Durch eine Protokollierung der Systemfunktionen unterstützt sie die Fehlersuche, weist auf etwaige Systemmißbräuche oder Attacken durch externe Dritte hin. Sie erlaubt die Protokollierung der GDI-Systemverfügbarkeit und belegt so beispielsweise die Einhaltung von Service Level Agreements (SLA).

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1. SPATIAL DATA INFRASTRUCTURE ACTIVITIES

All over the world, spatial data are considered to be important components of business processes and spatial data infrastructures (sdi) are the new concept to distribute them. sdi's are established on every regional level: townships, communities, regions, countries and are organized by global (GSDI), national (NSDI) and regional organizations.

But it is a big step from a simple Web Map Service towards a Spatial Data Infrastructure. An infrastructure has to comply to extensive further requirements with regard to integration and access (portals), security (access control and data integrity) and business model (eCommerce). But most important of all it must be reliable. It has to work everywhere and at any time. No one will rely on infrastructures which work at one moment and cease to exist at another.

Do our Spatial Data Infrastructures meet these demands? In many cases they don't. Many Spatial Data Infrastructures do not offer high availability. Which in fact, maybe not that import in view of the number of customers but could it be possible that they are missing because the reliability isn't secured? As a matter of fact, in many cases service breakdowns are reported by the customers, surely the worst method to monitor an infrastructure.
Having that in mind - while building up Spatial Services fo a mayor gas supplier - Service Monitoring soon came into focus and caused the authors to develop a downright new monitoring strategy for Spatial Services. Of course monitoring doesn't provide high availability but it is a basic step to decrease downtimes and to improve service quality.
Concept, architecture, achievements and restrictions as well as field activity results are presented in the following paper.

2. SDI MONITORING

2.1 What is the Idea?

The basic idea was simple: Put up an automat (monitor) which constantly watches a Web Map Server and alerts the system administrator in case of any malfunction. It should notify problems immediately by several means (mail, SMS), should support trouble-shooting by means of extended log files and such should help to minimize failure down times.

2.2 Components and Architecture

But further analysis of the problem made it much more complex. For instance: a monitor living on the same server as the service will die as well if the server breaks down and will not give the faintest sign. Or the fact that all service processes on the Map Server are up and running not sufficient for success because a disfunctional component somewhere on the way out to the user will impede the services availability just as well as a disfunctional server.

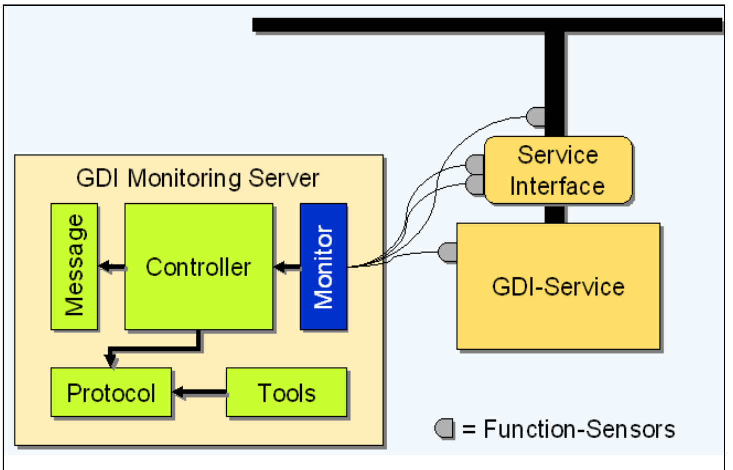

Figure 1 : Main Components

Clearly distributed services were the only solution which met the requirements. Actually the SDI Monitors architecture is similar to that of Spatial Data Infrastructures, a bundle of servers and services, distributed in the net and communicating to each other. Figure 1 shows the main components. The SDI Monitor consists of a Monitoring Server which in itself is composed of at least one monitor, a central controller, a message unit, a protocol unit with appropriate reporting tools and several function sensors.

The sensors do the actual watching while the monitor controls (start, stop) the sensors and listens to them. Each monitor is dedicated to one SDI service. It transfers all incoming messages to the controller.

The controller performs the two tasks. It writes each and every message to the protocol database which not only helps to detect system weaknesses but more important gives evidence of compliance with service level agreements. More important perhaps it alerts the server administration if something extraordinary happens by invoking the Message unit.

The message unit itself knows the administrators by name and in particular it knows their alert channels and sends them an appropriate message. In case of emergencies the administration team will be informed by SMS or e-mail.

While operating normally the system status can be controlled by means of a Web Client which graphically shows the system status and gives access to the protocol database.

The depicted Web Service on the other hand is used to provide status informations of other services – with other words it is used for machine communication.

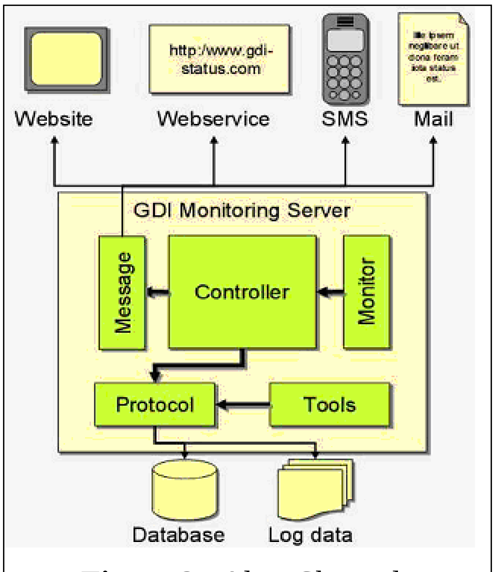

Figure 2 : Alert Channels

2.3 Sensors and Tools

Sensors and Tools are the workhorses of the actual monitoring. Each sensor has a specific task, is dedicated to a specific system functionality and therefore can (or has to be) tailored for its specific surroundings.

In most cases they are monitoring system availability, security and response time. But they can also check conformity with OGC-standards like Web Map or Web Feature Services [WFS, WMS], portal functions or verify the map content.
Tools are similar to sensors but follow another concept. Instead of being used constantly and periodically the are used from time to time control specific system components and usually work on local log files.

By deploying sensors and possibly monitor components locally and externally (by watching from an external internet server) not even the complete information flow can be monitored but performance (speed, response time) as well.

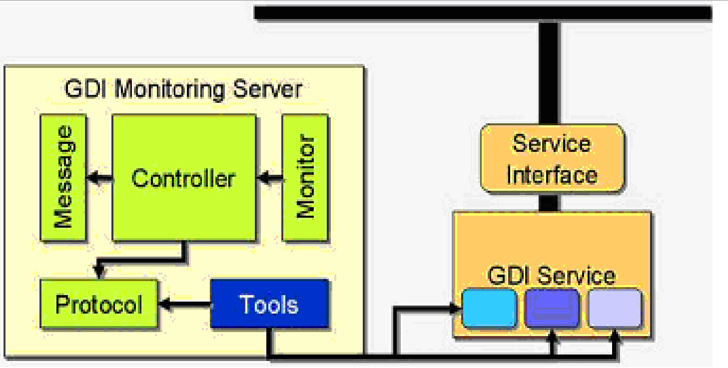

Figure 3: GDI Monitoring Tools

2.4 Software Platform

The SDI Monitor is not a solid piece of software but rather a network of loosely coupled java beans which are deployed into a java environment and use the J2EE framework for communication. All of them may be distributed on different servers. Therefore also the messages from several servers can be accumulated and even complex infrastructures can be monitored.
As the J2EE framework is used for all inter component communications the system is reasonably safe. As J2EE communications just require machine-machine communication channels (in contrast to open service interfaces) basically every deployment configuration can be realized.

3. CONCLUSIONS

Digital spatial information can be used everywhere but is far from being ubiquitous. The basic property of an infrastructure – reliability – has be assured and it's monitoring is one important measure. Without sustainable monitoring spatial services are subject to undetected failures and will not be accepted in business workflows of public [rs05] and industrial customers.

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BIOGRAPHICAL NOTES

Dr.-Ing. Martin Scheu
Martin Scheu received his diploma in surveying in 1990 and his Dr.-Ing. degree in GIS in 1995 from the Technical University Berlin. After finishing his postdoctoral thesis in 2000 he was appointed as head of the grit branch office in Berlin. His special working areas involve the capture and maintenance of spatial data in Utility Industry. He is a core member of the FIG network on standards and member of the national DVW-Working Group 2 (SIM). Additionally Martin Scheu joins the Utility Working group of the Deutscher Dachverband für Geoinformation (DDGI).

Dr.-Ing. Andreas Rose
Andreas Rose received his diploma in surveying in 1980 and his Dr.-Ing. degree in Photogrammetry in 1984 from the University Bonn. Together with Dipl.-Ing. Michael Zurhorst he founded the grit GmbH in 1989. In behalf of this company he was involved in a number of projects aiming at the reconstruction of the east German cadastre after 1991. His special working areas involve the capture and maintenance of spatial data in GIS and the use of Internet Techniques in data distribution and service. He is a core member of the national DVW-Working Group 2 (SIM) and Vicepraesident of the Deutscher Dachverband für Geoinformation (DDGI).

CONTACTS

Dr.-Ing. Martin Scheu
Technical University Berlin
Straße des 17.Juni 135
D-10623 Berlin
GERMANY
Tel. +49 30 466 06 280
Fax: +49 30 466 06 282
scheu@inge3.bv.tu-berlin.de
www.survey.tu-berlin.de

Dr.-Ing. Andreas Rose
grit GmbH: Berlin – Werne - Olpe
Landwehrstraße 143
D-59368 Werne
GERMANY
Tel. + 49 2389 9827 0
Fax: + 49 2389 9827 27
e-mail: rose@grit.de
www.grit.de