

Application of open source and proprietary software to optimise meadow bird management schemes in the Netherlands

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Abstract

Background

Our organisation has made considerable investments in proprietary GIS software such as ArcGIS, both in license fees, maintenance fees and training. These investments might impede the adoption of open source GIS software. The application of proprietary and open source GIS software in conjunction however, could be beneficial for many projects. It would allow organisations to benefit from both the investments in proprietary software and the advantages of open source software. Therefore, it was decided to investigate the feasibility of developing an internet GIS system in which both proprietary and open source GIS software are applied.

Methods and materials

A case-study from Dutch nature conservation - the development of a GIS-based knowledge system to support agricultural nature conservation groups in defining the optimal spatial-explicit management scheme for black-tailed godwits - was used to investigate the research question. An internet GIS application to enter data with regard to management schemes and black-tailed godwit territories was developed using Adobe Flex. It connects to a GeoServer WFS. Oracle Spatial was used as spatial database. An ArcGIS model was used to assess the quality of the management plan. To run the model, data is downloaded from the GeoServer WFS in shape-file format.

Results

The case-study shows that it is still quite difficult to develop a hybrid system in which open source and proprietary GIS software work in conjunction. Open source and proprietary GIS software are still not really interoperable. Improved support for open standards in proprietary GIS software would make the realisation of a system as the one described easier.

1 Background

As one of the first ESRI customers in the Netherlands, our organisation has made considerable investments in proprietary GIS software from ESRI such as ArcGIS, ArcIMS and ArcSDE, both in license fees, maintenance fees and training. These investments impede the adoption of open source GIS software, as ESRI software will be utilized whenever possible when creating a new internet GIS system, without considering the alternatives. The reasons are:

- The ESRI software is readily available
- The different components of the system will interoperate seamlessly
- Users can benefit from the training in ESRI products
- Users are experienced in the use of ESRI products

This experience is confirmed by experiences in other organisations. Goode investigated why Australian firms do not adopt open source software (Goode, 2005). One of the reasons why managers rejected open source software was that they had adopted other (proprietary) software that they believed to be incompatible with open source software. Holck et al. conclude that decisions regarding the use of software are seldom taken based on the quality of an individual component (Holck et al., 2005). Usually, management decides upon a common IT policy and enterprise architecture and if open source software is not part of this framework, it is unlikely to be adopted on any significant scale, not even if the open source software products are competitive. Glynn et al. investigated the rationale behind the adoption of open source software and found that the existence of a coherent and planned IT infrastructure based on proprietary software served to impede adoption of open source software (Glynn et al., 2005).

The application of both proprietary and open source software in conjunction however, might be beneficial for many projects. The combination will allow organisations to benefit from both the investments in proprietary software and the advantages offered by the application of open source software. For our organisation, an important advantage of open source software would be the fact that open source software embraces open standards (Simon, 2005). The application of open standards facilitates integration with GIS software used by other organisations and enables the exchange of software with those organisations without forcing them to invest in proprietary software if they do not have the proprietary software used at their disposal yet.

Many studies on open source GIS software focus on the competition between open source and proprietary GIS software. Software architectures consisting entirely of open source GIS software and the advantages and disadvantages of the application of open source software are being discussed. Holmes for instance describes a spatial data infrastructure (SDI) for Zambia based on open source software (Holmes, 2005). In other cases, open source GIS software is used to settle issues with regard to differences in IT infrastructures in cross-border GIS systems (Moreno-Sanchez et al., 2006, Moreno-Sanchez et al., 2007, Anderson and Moreno-Sanchez, 2003). Dunfey et al. describe a software architecture for an internet vector GIS based on open source software and

Scalable Vector Graphics (Dunfey et al., 2006). The authors find that open source software tools are not necessarily interoperable with proprietary software.

Caldeweyher et al. describe the OpenCIS project (Caldeweyher et al., 2006). The aim of OpenCIS is to provide local communities with GIS functionality and it is based on open source GIS software (MapServer). Kamel-Boulos and Honda provide instructions on how to publish health maps on the internet using UMN MapServer and DMSolutions MapLab (Kamel-Boulos and Honda, 2006).

However, literature on systems in which open source and proprietary GIS software work in conjunction was not found. Therefore, the following research question was investigated: are open source and proprietary GIS software sufficiently interoperable to be used together in one system?

2 Methods and materials

A case-study from Dutch nature conservation which entailed the development of an internet based GIS was used to investigate the research question.

The grassland in the Netherlands forms a vital part of the habitat of meadow birds, of which the black-tailed godwit (*Limosa limosa*, see Figure 1) is a so called flagship species. A large portion of the European population is breeding in the Netherlands (ca 60%), but numbers are declining rapidly since black-tailed godwits cannot keep up with changes in the management of grassland to optimise yield for the farmers. There is not enough opportunity for the black-tailed godwit to breed and rear chicks: nests are trampled by cattle or damaged while mowing, the availability of food (insects) has diminished and predation of offspring has increased.

Protection of the black-tailed godwit is an important element of Dutch nature policy. Nature conservation bodies as well as farmers are involved with management schemes. The farmers, united in agricultural nature conservation groups, formulate management plans to manage their meadows in a mode which is thought to be beneficial for the species and which fits in with the daily conduct of business. Spatial planning happens to be a rather complex process. A GIS-based knowledge system was developed to support the agricultural nature conservation groups in defining the optimal management scheme for black-tailed godwits.



Figure 1 Black-tailed godwit (photo Danny Ellinger)

This system consists of a number of components. Representatives of the agricultural nature conservation groups are allowed to log in to an internet GIS application. This application can be used to enter management schemes for all parcels individually. If present, data on the distribution of black-tailed godwit territories can be entered as well.

The management and territorial data collected using the internet GIS application are used as input for an ArcGIS model. Using this model, the quality of the management plan for the survival of the chicks is assessed. This information can be used to optimise the plan. Focus in this model (up till now confined to the black-tailed godwit) is to provide chicks with grassland vegetation which provides shelter and food at the right time and place. These qualities depend on management and landscape features. The model produces maps which show where and when there is a shortage or a surplus of such land. In case of a shortage or a surplus, agricultural nature conservation groups may decide to adjust their management schemes accordingly.

3 Results

The internet GIS application runs inside a web-browser using the Flash Player plug-in. It connects a transactional Web Feature Service (WFS) to insert, update and delete information with regard to the management schemes and observations. A transactional WFS allows a client to retrieve and update geospatial data encoded in Geography Markup Language (GML) (Open Geospatial Consortium Inc., 2005). Map images for the internet GIS application are produced by a Web Map Service (WMS). A WMS dynamically produces digital images of spatially referenced data (Open Geospatial Consortium Inc., 2004). Spatial data are stored in a spatially enabled relational database and not using a file format. Storage of data in file formats can lead to problems with regard to data security and concurrency. Database management systems however, do contain functionality for user authentication and multiple concurrent users (Rigaux et al., 2002).

Table 1 contains an overview of the software used to develop the system. The internet GIS application was developed using Adobe Flex, a platform independent platform for developing rich internet applications. The open source internet GIS server GeoServer was deployed to handle WFS and WMS requests since it supports both the transactional WFS and WMS standards and is easy to install, configure and maintain. GeoServer was connected to an Oracle Spatial database to store the spatial information. Oracle was chosen since it is a high quality database management system which is readily available within our organisation and can be used without additional investments or effort of the project team. The model was implemented in ArcGIS using Python. ArcGIS contains the spatial analysis functionality the meadow bird experts needed for the model.

Table 1 Software used to develop the system

	Software	Version
Client	Adobe Flex	3
WFS	GeoServer	1.5.4
Database	Oracle	10
Spatial analysis	ArcGIS	9.2

The connection between GeoServer and Oracle was no problem at all. An extension which adds support for Oracle to GeoServer is available from the GeoServer web-site. Installation and configuration of this extension is a breeze. The link between ArcGIS and the other components of the system however, proved more cumbersome to achieve than anticipated. Three ways to connect the ArcGIS model to the other components of the system were investigated. These are summarized in Figure 2.

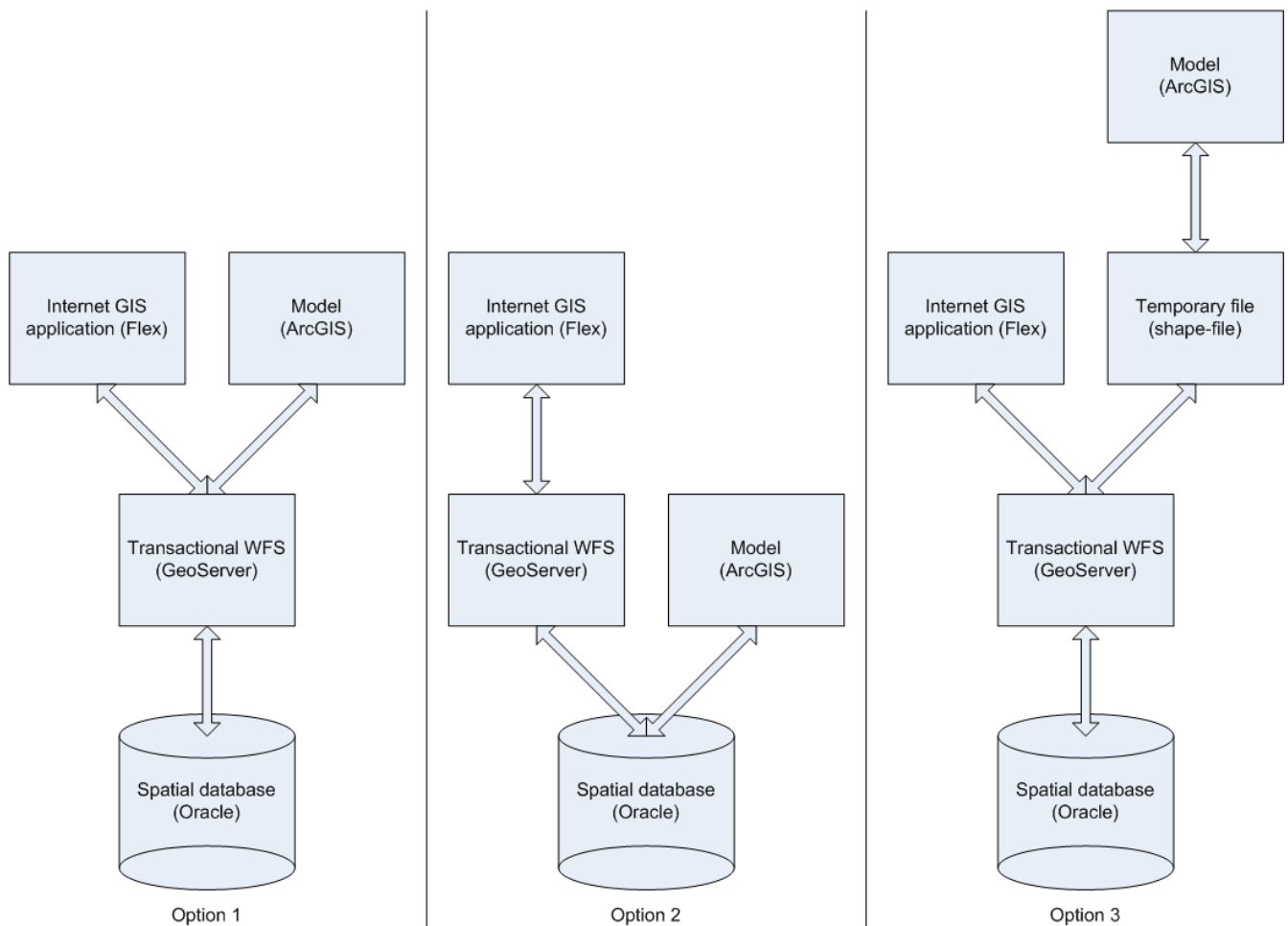


Figure 2 Ways to link the various components

The chosen option (option 1) was to connect both the internet GIS client and the ArcGIS model to the WFS directly. In this option, the ArcGIS model would read spatial data from the GeoServer WFS, use them in the model and write the results to the GeoServer transactional WFS again. This option could not be used as the ArcGIS version used does not support the WFS standard.

The second, less desirable option (option 2) was a link at database level. Both GeoServer and ArcGIS would then read and write spatial data from the same database. The only spatial database format supported by both GeoServer and ArcGIS is ArcSDE. This option proved infeasible as well, as an ArcSDE license was not available for this case-study.

Therefore, we had to resort to the third, least desirable option (option 3): exporting the end-users data to temporary shape-files and using these shape-files as input for the ArcGIS model. This is not a very robust solution.

In addition, the presentation of spatial data to representatives of the agricultural nature conservation groups was made more difficult as a result of the fact that GeoServer and ArcGIS do not dispose of a common file format to store symbolization: GeoServer uses a Styled Layer Descriptor (SLD) XML file, ArcGIS stores symbolization in a map document or a layer file.

4 Discussion

The case-study provided us with insight in the interoperability of open source and proprietary GIS software and thus the possibilities of using open source and proprietary GIS software in conjunction. Conclusions can only be drawn about this application in its specific context (Colorado State University, 2008). Conclusions based on this case-study only apply to similar software architectures in which open source GIS software is being linked to ArcGIS. Furthermore, results are restricted to current versions of the software.

The case-study shows it is still quite difficult to develop a hybrid system in which open source and proprietary GIS software work in conjunction. Open source and proprietary GIS software are still not really interoperable. Connecting GeoServer and Oracle proved no problem at all, but due to the lack of implementation of open standards by ArcGIS the realisation of the link between ArcGIS and the rest of the system proved more cumbersome to achieve than anticipated. Improved support for open standards in proprietary GIS software (particularly WFS and SLD in this case) would make the realisation of a system as the one described easier.

This might also simplify the adoption of open source GIS software. It has been established by various authors that open source GIS software can be used to develop a GIS. However, investments in proprietary GIS software impede the adoption of open source software. This prevents many organisations from benefiting from the advantages of open source software. If open source and proprietary GIS software could easily be used together, organisations could have the best of both worlds.

5 Conclusion

Open source and proprietary GIS software are not really interoperable. This complicates the realisation of a system in which open source and proprietary GIS software work in conjunction. To facilitate the integration between open source and proprietary GIS software, support for open standards in proprietary software needs to be improved.

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