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Centre d´Esdeveniments-Fira València

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Propuesta de comunicación 5as Jornadas gvSIG
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Tipos de comunicación (Seleccione una o ambas) / *Types of paper (Select one or both)*:

☐ Ponencia / Report ☐ Póster / Poster

Título / *Title*:	El uso de gvSIG y el desarrollo de extensions para gvSIG como client standard para una infraestructura que se basa en Web services GIS (SIG) para la "provincia autonoma di Bolzano"
Título en inglés / *English title*:	The use of gvSIG and the implementation of gvSIG extensions as a standard client for an infrastructure based on GIS Web services within the Autonomous Province of Bolzano

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Página web de referencia (si el trabajo realizado dispone de ella) / *Related web page (if the project has anyone)*:

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1. Summary

This article presents the innovative infrastructure for the management and publication of geodata of the Autonomous Province of Bolzano and explains in detail two specific applications currently being developed. The new infrastructure is intended to replace the existing environment in within the next two years. Over the last decade a complex environment has grown with a high number of solutions and applications based on a lot of different technologies. This variety of technologies and the missing common approach causes a lot of effort for maintenance. End of 2007, the strategic project newGIS has been initiated. The goal of this project is the creation of an environment able to handle several requests of geodata management and publication. This paper presents the results based on two specific software modules, currently being implemented: WG_EDIT - editing of the road network with gvSIG; geneSIG – editing with gvSIG to interact with the new infrastructure.

Keywords: gvSIG, Web Service, editing, geodata management, topology

2. History

In the last twenty years a lot of complex applications for specialized users were developed, most times using the technology of that time. Some of these applications are still in use.

In the beginning of the 90ies applications were implemented with the data management based on the topological standard of the ESRI coverage like the "urban planning system".

The following 5 years were defined by the diffusion of the GIS-Tools, mostly using the non topological structure of the ESRI shapefile.

The first 5 years of the 21st century were dominated by two parallel developments: the diffusion of the data trough the WEB (map services) and the centralization and standardization of the geodata (e.g., central geodatabase ARCSDE, unified coordinate system UTM-WGS84, organizing the relation between the geodata management system and the map service system by creating a metadata catalogue).

The last years were characterized by a strong increase of requests for solutions with geodata management from the departments of the public administration. This increase was caused by both the developments described above as well as the expansion of publicly available applications like e.g., GoogleEarth and mobile navigation.

The existing solutions and the current architecture are rather complex and don't allow a flexible enhancement by new applications. Furthermore, it takes an extremely high effort to maintain the complex environment and keep the applications running and working together. For this reason, it is necessary to review the simple GIS-Tools and the environment grown over the last decade in order to reduce the effort for the department responsible for the provision and support of the GIS-Infrastructure.

End of 2007 a strategic roadmap has been defined to offer a solution for both demands. This has been initiated within the strategic project newGIS.

3. Objectives

The Department of Statistical and Geo Informatics has decided upon the following objectives for the future GIS Infrastructure and the future geodata management:

-The database is responsible for data integrity and data security. It should not be the duty of the client or the middleware. The infrastructure giving the guarantee is a geo-relational structure based on a persistent topology accessed by an application server. This application server should be able to manage topology rules.

-A tree-tier architecture with precisely defined levels (database, application server/business logic,

clients) and a standardisation of the communication interfaces within these levels (Web Service and XML/GML) is necessary.

-Unified management of geodata and alphanumeric data within the same database. In this sense, geometry is not more than an attribute.

-The system has to cover a large number of requests with a manageable complexity. Therefore the costs of the clients have to be low and there has to be a server side meta-configuration of the structure.

-It is required to manage and control the GIS infrastructure and the GIS systems with reduced costs for maintenance.

-The visualisation of the geodata within a simple map service should be expanded to supply GIS Services e.g. making a spatial analysis by asking a Web Service using a GIS functionality. One objective is to create a GIS service oriented Internet platform.

The objectives listed above are the basic principles of the newGIS project. According to them the new infrastructure provides a lot of interfaces. For this reason many clients can be used to interact with the new infrastructure like shown in Fig. 1. Nevertheless, there has to be one "standard client". According to this "standard client" the following requirements of a GIS client were defined:

-complete GIS-Tool (e.g. Editing, many interfaces for data and services, Layout, large number of analysis functionalities)

-free/open source product or a licensed tool, but with open standards

-GIS-Tool with guarantee of continuity

-User friendly interface (GUI)

Fig. 1: Communication between Client and new Infrastructure (newGIS)

The GIS application gvSIG fulfils the requirements and was chosen to be the "standard Client". gvSIG will be the new standard interface within the project newGIS and substitute the ESRI "ArcView 3.2a" Client. Within the project newGIS there are two software modules currently being implemented as an extension of gvSIG:

-Module 1 WG_EDIT: data management of the road network and correlated objects

-Module 2 pilot project geneSIG: editing functionalities to interact with the new data structure.

WG_Edit focuses on the management of geodata by using the new client gvsig implementing the communication with the application server defined above. In contrast to that, geneSIG goes one step further and addresses the interface between the application server and the underlying geodatabase including topology rule checks, too. In the following chapters these two modules are described with more detail.

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4. Module 1 WG_EDIT

This module is an existing module within the "WEGE" project and is at the moment an application working with ESRI "ArcView 3.2a" software. During the creation of the guidelines for the strategic newGIS project, this module was considered to be the first real implementation in gvSIG.

"WEGE" is a geographic information system for the road infrastructure management (road types, bridges, tunnels, etc.) and correlated elements (public transport, petrol stations, bus stops, street numbers, etc.). Furthermore, an internet platform for the communication and visualisation of the collected information was created within the project as an e-government service (G2G, G2E, G2C). One goal of this project is to unify and manage the whole data concerning the road and traffic topic within the same module based system. To achieve this objective, collaboration and coordination between the stakeholders is necessary. The more data is stored, the more the number of persons collaborating is increasing, the more the system is becoming complex. The more people are collaborating, the more complete and up-to-date the data is, the more the data can be used by others e.g. for localization during emergencies by the civil protection office.

This means for the department of providing GIS Infrastructure to keep the system running at all times and to observe the technology development in this sector in order to implement new interfaces and introduce new technologies. The module WG_EDIT is considered to be a step for introducing state-of-the-art technologies. The following part describes the data structure of the system "WEGE".
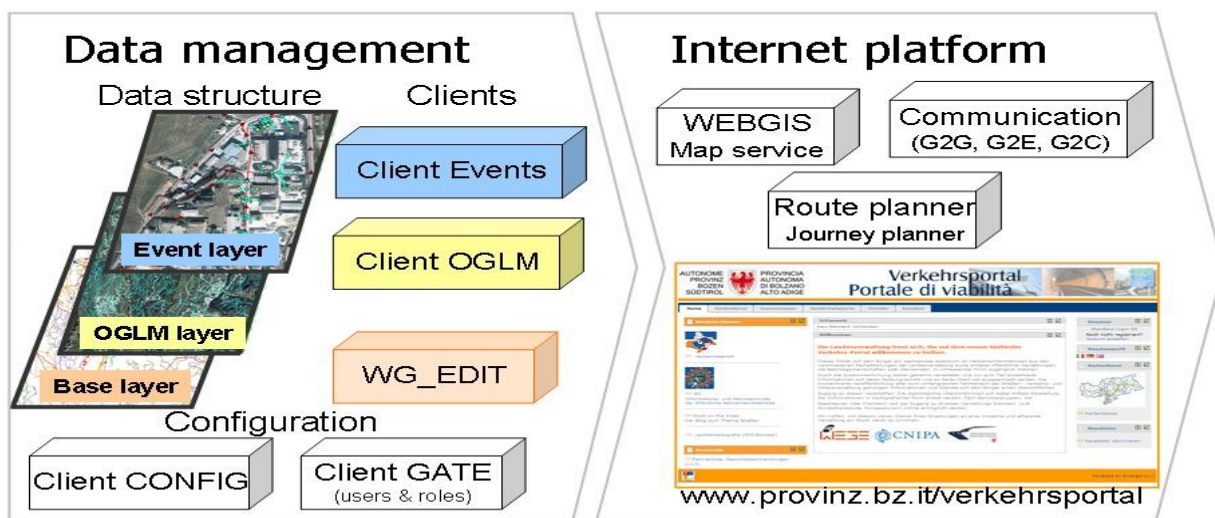

Fig. 2: Project "WEGE" - structure & software modules

The data management is based on an efficient, time variance and normalised multilayer structure as shown in Fig. 2:

-Base layer: management of the road network (topology)

-OGLM layer: (OGLM - **O**ggetto **G**eometrico **L**ineare **M**isurato, eng: linear measured geometric object) management of elements correlated to the road network (information based on the road network) e.g. public transport routes, bicycle routes, hiking routes

-Event layer: management of elements correlated to the road network, which can be one of these three formats: points on the road, a double point (relative position of the element on the road and

real position of the element) e.g. bus stops, petrol station, and linear elements as part of the road e.g. bridges, tunnels, pavement.

For each layer an application exits which offers the user the necessary functionalities to manage the elements. Fig. 2 shows the specific modules (applications) next to the layer. The Client for Events and OGLM's are Java Clients. The application for the base layer is the module we are talking about in this article and will be explained more in detail here. The module is called **WG_EDIT**: WEGE + EDITING = WG_EDIT.

The module WG_EDIT provides the functionalities to manage the road network. The architecture of the module is based on a three-tier-architecture as shown in Fig. 3. The data (geometry and alphanumeric) is stored on an Oracle/ArcSDE database server. The application server provides the necessary Web Services to interact with the client and the database. Beside these interactions there is also a communication between the Web Services WG_EDIT and the map service.

The users interface is based on the GIS Tool gvSIG, including an extension covering the specific functionalities for the management of the road network, the module WG_EDIT. Each user has certain rights, which allow him to create, modify or delete objects of the road network. With the administration tool called "GATE" module (Fig. 1), it is possible to configure roles and users. Furthermore, "GATE" allows the management of the user rights.

With the activation of the extension WG_EDIT within gvSIG a toolbar with the functionalities will appear. As a first action, the user has to login with his user name and password. The GATE Web Service checks the users permissions and rights in order to activate only the allowed features and functionalities.

After the login the user is free to use the functionalities within the users rights. The users interface is supported as a background cartography by a map service (WMS, WFS). However, the map service is communicating with the Web Services e.g., redirecting spatial selects or for spatial queries.
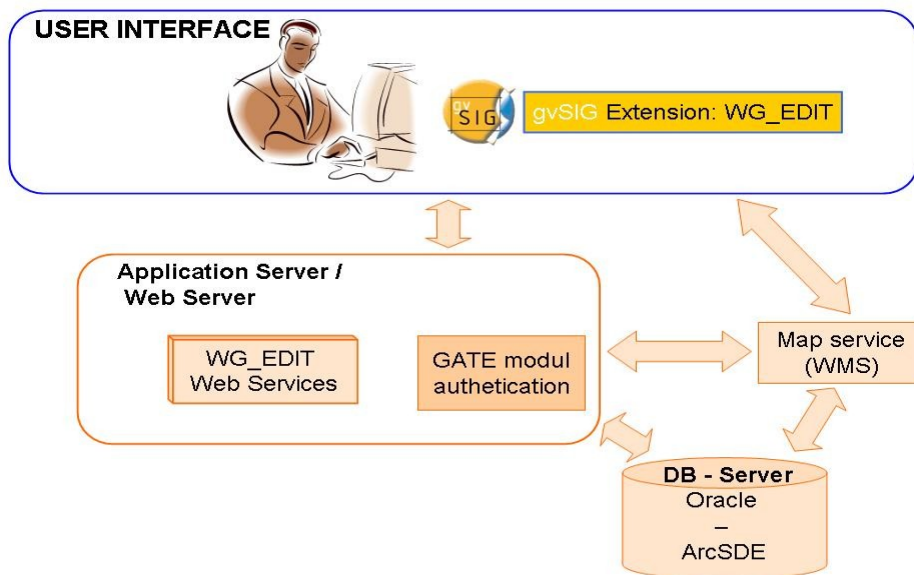

Fig. 3: Architecture of the WG_EDIT module based on gvSIG

The WG_EDIT module is based on the following objectives:

-obtain a topological correct road network

-maintain the objective of a flexible and open system like it is the aim of the general project "WEGE"

-offer an innovative application

-manage the geometry including the z-coordinate (elevation)

-offering the specific functionalities for the editing of a network

-provide a multi-user application considering the user access rights

-assure the user's requirements

The client WG_EDIT will provide the following functionalities: user's requirements cover the following actions:

-import the geodata from GPS acquisition to the database.

-digitalization of new roads (geodata) by the support of cartography e.g. Orthophoto.

-editing the geometry of the data stored on the database (reshape, substitute, add).

-insert or modify attributes of the data and manage the connection between the attributes and the geometry (multi table structure connected by foreign key defined by the database infrastructure).

-Calculating the z-coordinate on the basis of the digital terrain model

-Editing the z-coordinate manually within the Profile Graph

-Special functionalities for managing the nodes and multi-part lines in order to guarantee the network topology rules: e.g. create vertex, rearrange parts of a multi-part line, check snapping errors.

-query functionalities, e.g. query a road or an extent of a municipality

One new request of the users regards the aspect of editing and calculating the z-coordinate (elevation). Especially the profile visualisation (with respect to the visualisation for biking and hiking citizens) and the calculation of a "real" length considering the elevation are two important uses of the elevation data management. Considering these requests the elevation editing was introduced into this module.
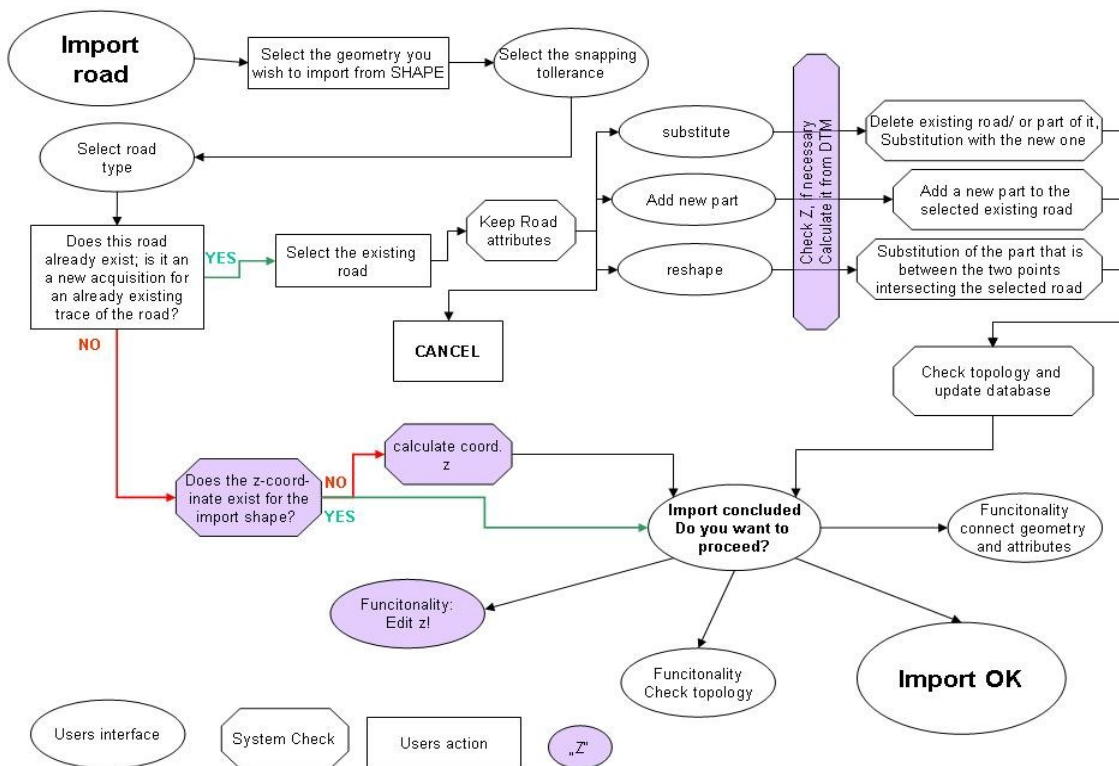

Fig. 4: process of the functionality "import road"

As this module is a remake of an existing module, the basic requirements and technical specifications already exist. However the introduction of the z-coordinate is a new feature. This aspect was included in the analysis of the module WG_EDIT and all the existing documentation was

extended by considering the detailed process for each functionality including the z-coordinate. The new WG_EDIT module as an extension will offer a toolbar with the functionalities mentioned above. As an example, the process of the function "import new road" is shown (Fig. 4).

Fig. 4 explains the process of the functionality "import road". The difference between the user's action, the user's interface and the system checks is displayed. Importing a road into the system is not simply a "load data" as further constraints need to be considered. It is also required within a road network to comply with topology rules and system rules: e.g. a road has to be connected to the others (snapping), the overlay (of lines) has to be avoided, the correct creation of the nodes has to be assured.

Now the analysis of the module is terminated and the implementation started. The implementation will be concluded within march 2010. Afterwards, there will be organized courses to transmit knowledge about gvSIG including the special functionalities developed within the module WG_EDIT e.g. editing of the z-coordinate. This will be the opportunity to introduce gvSIG as new software into the public administration. With respect to the principles of the second module we plan also to substitute ArcView 3.2a within this period.

5. Module 2 pilot project geneSIG

The project **geneSIG (Genesis + gvSIG)** consists in the construction of the core components of the new infrastructure. This components handle the interface between the application server and the underlying database defined by the newGIS project. Additionally a client application that works a pilot project is developed in order to obtain a complete, testable and usable system.

In particular, geneSIG follows the objectives described in chapter 3. The first goal of the objectives in chapter 3 defines the requirements for the database being responsible for data integrity, data security and the management of the topology. Considering these requirements, the Autonomous Province of Bolzano chose ORACLE SPATIAL as the database for the geodata storage. With Oracle Spatial the features of the persistent topology and the Spatial SQL are available. Spatial SQL will be used for querying and managing geographic data e.g. also by clients being not necessarily GIS-Tools. Furthermore the users rights management based on the standards given by the guidelines of the newGIS project is applied to all the GIS data and the GIS services.

The infrastructure for newGIS is designed as a multilevel-structured service. It is based on the assumptions set out above, the objectives listed in chapter 3, in accordance with the guidelines of the Open Geospatial Consortium (OGC) and even more by the document CEN/TR 15449th of the European Committee for Standardization (CEN). The layers are defined as following:

•an application layer, which is the access point to the end user, typically achieved through a geographic portal and/or specific clients

•a middleware layer, which implements a set of distributed components as defined in a SOA architecture (this level may in turn be logically divided into several levels depending on the characteristics of the components that belong to it)

•a data level, on which reside all referenced data

The architecture is divided into modules. These various modules are part of one of the two different environments: server and client as shown in Fig. 5.
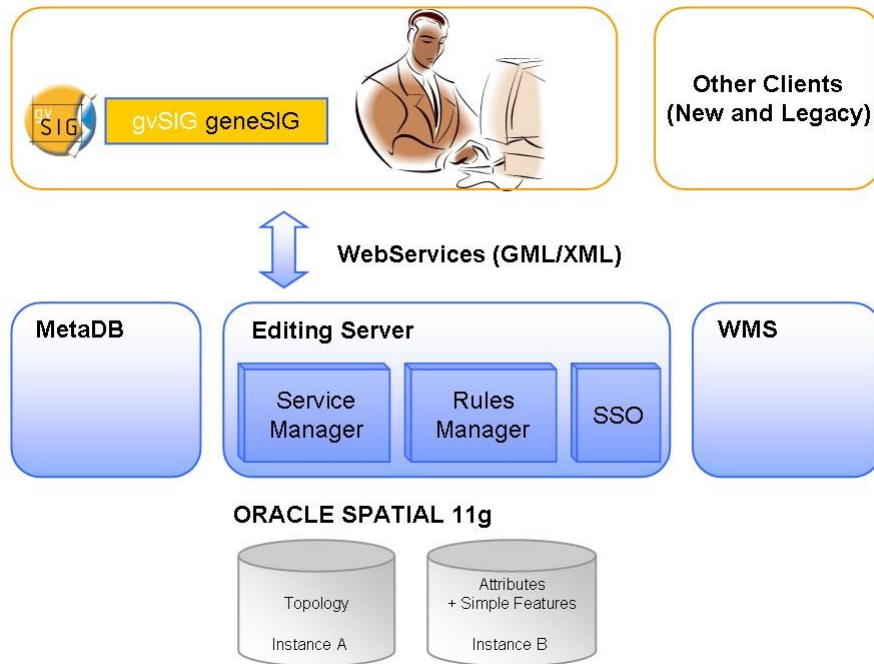
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Fig. 5: The architecture of geneSIG

The server environment consists on one hand of the Editing Server, the MetaDatabase and the component WMS and on the other hand of the ORACLE SPATIAL database instances:

The server environment:

The module **Editing Server** is needed to expose to the components of editing the following information:

•the definition of the project (editing layers, base maps, services, rules, error messages, ...)

•newGIS Web Services of the categories basic and composite (orchestrated)

•newGIS rules of the categories blocking and non-blocking, and their error messaging

•permissions and the types of data export

•user profiles, roles and groups

•definition of layers and their location

Moreover, the Editing Server performs the export of data from the central database to newGIS clients and the data import from newGIS clients to the database. Within this module there are three sub modules:

•**SSO Managing roles/groups:**
Profile forms of roles and groups will perform the configuration of roles and groups of users taken from the Active Directory used by the PAB.

•**Rules Manager:**
The Rules Manager will be used to control rules associated with newGIS editing layers previously configured with the module metadatabase.
If there are errors, the data will not be included in the centralized database system newGIS and newGIS clients will be sent the appropriate error message.

In the case of no errors, the data will be included in the centralized database system newGIS.

•**Services Manager:**

The module "services manager" manages basic services and composite (orchestrated) services. Indeed, through this the system administrators will be able to compose their services orchestrations choosing from the catalogue of services made available by the system newGIS.

The **MetaDatabase (metaDB)** is the client for the configuration of the editing environment. Through this module, the system administrator will be able to design projects, define their rules, establish services, set base maps and configure editing layers. The creation of layers and their topology is done through the desktop client called "TopologyLoader". The Client TopologyLoader will be implemented in parallel in order to allow the administrator of the system to migrate the data from the current database to the new database oracle spatial including topology.

The **WMS component** exposes the base maps to newGIS clients. They are associated with projects and configured through the configuration of editing.

The Client environment:

The client environment is based on the customization of gvSIG capable of interfacing with the infrastructure newGIS and utilize its capabilities. The client geneSIG is developed in Java and comes as an extension/plug-in to be used together with gvsig. Essentially there will be created a toolbar/menu that allows the user to interact with the infrastructure. The client geneSIG will have the following functionalities:

•multilingual interface (Italian and German) in all of its components

•provision of user authentication through the newGIS application server

  •allow the user to load a project previously configured and saved in the metaDB provided the the user has access rights. The opening of the project geneSIG requires the automatic loading of a WMS base map (associated to the project as a simple URL in the metaDB), the provision of themes in the TOC with their configuration and taking all the server information/configuration needed for managing the project on the client side.

•support by a multi-user access management to projects with control of conflicts on geometries (flow of lock/unlock)

•support local projects

•support the management of transactions by the following functions:

    •Start Editing (opening the transaction)

    •Save Edits (provide to editing server the geometries changed during the transaction)

    •Stop Editing (closing the transaction)

    Transaction: In geneSIG, the term "transaction" means the period between the Start Editing and Stop Editing, within which the user can edit geometric and alphanumeric data and all the time in which data remains locked in the database. This concept is applicable because the user does not interact through direct transactions with the database, but only through the Editing Server that will manage the transactions. Between the Editing Server and the database there will be short transactions only.

•editing of editable features (points, lines and polygons in GML/XSD), belonging to all the layers defined as editable for that user

•send to the application server the changes for verification of newGIS-rules (direct or indirect),

specified for that layer through the metaDB.

•allow the user to encode and recode the geometries using lookup tables on remote databases and to insert and modify alphanumeric data (notes, comments, etc.).

•after each geometric modification (save edits) see updated simple features (field SDO_GEOMETRY on tables of the instance B), configured as replicas in the metaDB

•allow the use of some Web Services within the client for:

> •modify geometries
>
> •check geometries
>
> •query data on local and remote databases taking into account multilingual access

6. Outlook

The Autonomous Province of Bolzano plans to use gvSIG as the "standard-GIS-client" within the public administration.

gvSIG shall substitute ESRI clients (3.x/ArcGIS ArcView 9.x) currently in use and moreover be utilized for personalized clients. The projects WG_Edit and geneSIG described in this document are a first step in this regard.

The characteristics of gvSIG, OpenSource & Communities, promise fast and effective adaptation to the specific needs and appropriate support. Moreover the public administration expects to reduce current licence costs.