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geneSIG – A customized gvSIG client for the newGIS Infrastructure

Persona de contacto / Contact person:

Helmuth Leitner

e-mail de contacto / Contact e-mail:

Helmuth.Leitner@provincia.bz.it

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

**Autores de la
comunicación /
Paper authors:**

Helmuth Leitner - Autonomous Province of Bolzano – Department of Statistical and Geo Informatics (Bolzano)

Alessio Modena – Trilogis (Rovereto)

**Ponentes (Nombre y
organización) (máx.
2 personas) /
Speakers (Name and
organization) (max. 2
persons):**

Helmuth Leitner - Autonomous Province of Bolzano – Department of Statistical and Geo Informatics (Bolzano)

Alessio Modena – Trilogis (Rovereto)

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1. Summary

This article presents the geneSIG extension for gvSIG. geneSIG is a client application for the newGIS Infrastructure, the GeoData Management System of the Autonomous Province of Bolzano. gvSIG with its already existing rich GIS functionality and its extension model for personalization and implementation of customized features has been chosen as the underlying technology for the geneSIG Client Application. This paper shows, why the decision for the newGIS Infrastructure has been taken, gives an overview of the most important parts of it and explains the implementation of features of the newGIS Infrastructure in the geneSIG Client Application with details about technical aspects of their implementation along with problems that have been met.

Keywords: gvSIG, gvSIG Extension, Editing, Topology, WebServices

2. The Decision for the newGIS Infrastructure

In the beginning of the 90's in the public administration of the Autonomous Province of Bolzano applications were implemented with the data management based on the topological standard of the ESRI Coverage. The following years were defined by the diffusion of Desktop-GIS-Tools, mostly using the non-topological-structure of the ESRI Shapefile. With the advent of the internet the diffusion of geodata through the web increased dramatically and subsequently the requests for geodata-management-solutions from departments of the public administration were also becoming numerous.

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.

At the end of 2007 the decision for the newGIS Infrastructure project has been made with the objectives:

- The database is responsible for data integrity and data security
- A 3-tier architecture: database, application server, interchangeable clients
- Standardisation of the communication interfaces (WebServices)
- Unified management of geodata and alphanumeric data within the same database (geometry as an attribute)
- Manageable complexity
- Reduced costs for maintenance/reduced costs for licenses

3. The newGIS Infrastructure

The newGIS Infrastructure is a 3-tier-architecture consisting of a database layer, an application layer and interchangeable client applications.

For the database layer ORACLE SPATIAL has been chosen as 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.

Important: 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.

For the application layer the Java EE technology, specifically the JBoss AS is being used. The application server environment consists of the Editing Server, the MetaDB and a WMS. The module Editing Server is needed to expose to the editing components the following information:

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

The various newGIS clients never access the database directly but instead communicate through the application server according to standardized interfaces. For the communication between clients and application server solely WebServices (GML/XML) are being used.

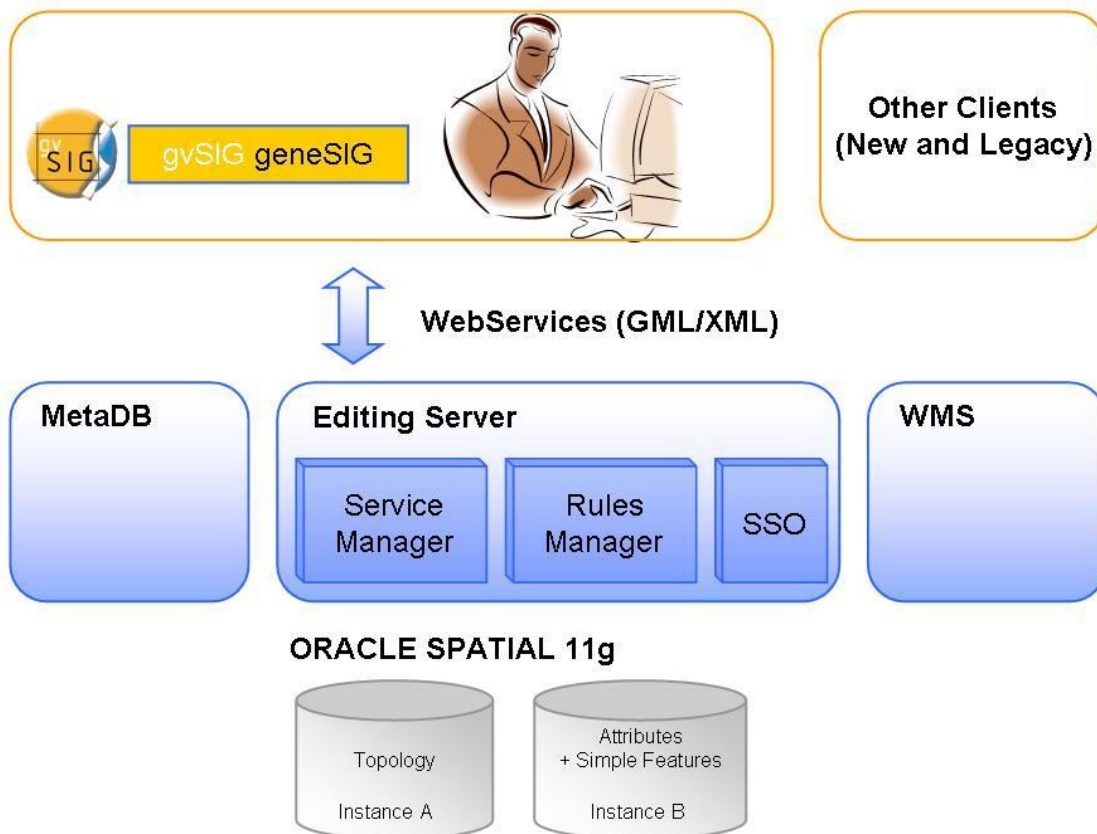


Figure 1: 3-tier newGIS Infrastructure

It is expected that various newGIS clients will be developed according to the needs of the users. The first implemented client is a personalized and extended gvSIG, called geneSIG.

gvSIG was chosen as a GIS client for the following reasons:

- Complete GIS tool with included editing functionalities
- User-friendly GUI (which by the way the existing ArcView 3 user base is accustomed to)
- Extension model for personalization and implementation of customized features

- Free of license costs

4. *geneSIG Client Application*

geneSIG was developed using the extension model of gvSIG.

Features implemented through these extensions are:

- Multilingual interface
- Authentication of the user (Active Directory authentication)
- Predefined projects with all their properties
- Multiuser-support through profiles, roles and rules
- Support of editing including transactions
- Support of rules upon the various layers including topological rules
- Services for selecting data and geoprocessing tasks

The geneSIG client is based on gvSIG version 1.9

No original source code of gvSIG has been changed; instead a GUI with the required functionality has been developed. Moreover dedicated toolbars were created.

In addition to the standard JDK and gvSIG components a series of further libraries has been used: GeoTools 2.6.2 for transforming data in GML, JTS 1.10 for the base geometry model, JAX-WS native in JDK 1.6 for invoking WebServices, JAXB for persisting data locally as XML, Spring 3.0.1 as dependency manager (IoC, AOP, etc.) and Jakarta-libraries.

The major development areas of geneSIG:

- Architecture module
Through the use of Spring IoC and custom class loaders the configuration of geneSIG is allowed dynamically, without the complexity of OSGi on the client side; different versions of libraries can be used, hot reload of libraries is possible (live update).
- Spatial data module
A custom driver has been introduced to map GML spatial data generated by GeoTools to gvSIG VectorialDriver; manage user permissions.
- GUI module
Extends the concept of IWindow to allow customization of tools depending on the type of view; change the behaviour of gvSIG table to add validation on look-up attributes; various other customizations.
- Persistence module
Extends the concept of gvSIG document model to persist the newGIS data-structure locally.

List of functionalities of geneSIG:

- Remember last opened Workspace
- Open Remote Workspace (a Workspace represents a user Lock Area)
- Open pre-configured Project (a Project contains layer definitions with all their information for managing the project on the client side)
- Manage user permissions
 - hide layers if the user has no right to read
 - disable editing for read-only layers
 - allow editing of the geometry if the user has adequate permissions
 - display alphanumeric data depending on read permissions
 - allow editing of alphanumeric data if the user has adequate permissions
 - allow to save spatial data or the TOC locally based on adequate permissions
 - allow to save spatial data or the TOC remotely based on adequate permissions

- Disable tools/enable extensions depending on the type of view
- Local persistence of each layer (GML), Project, Workspace
- Invoke newGIS Services, e.g. remote data query, validation of geometries, geoprocessing of geometries (Buffer, Merge, ...)
- Execution of topology rules
Local execution of topology rules is realized through JTS and gvSIG Topology Extension to find potential errors on spatial data.
- Management of topological errors
Topological errors are displayed before geometries are saved remotely.

Authentication

All geneSIG extensions are enabled only after the user has been authenticated. Authentication is done on the Active Directory through LDAP/Kerberos. In gvSIG the implementation is realized through ExclusiveUIExtension.

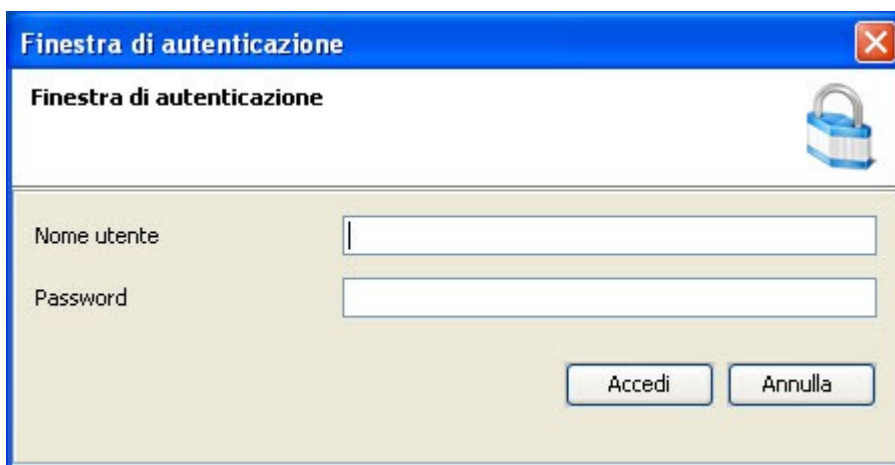


Figure 2: User Authentication in geneSIG

Projects and Workspaces

The Project represents the logical container of spatial data.

After the user log-in the Projects Manager Dialog is displayed. (Only projects with the appropriate permissions are displayed.)

The Workspace represents a spatial region.

Only the creator of the Workspace can apply changes to it. Conceptually a Workspace is a long transaction editing session on a spatial bounding box (Lock Area).

Workspaces are managed in the Workspace Manager Dialog and are persisted locally for each user.

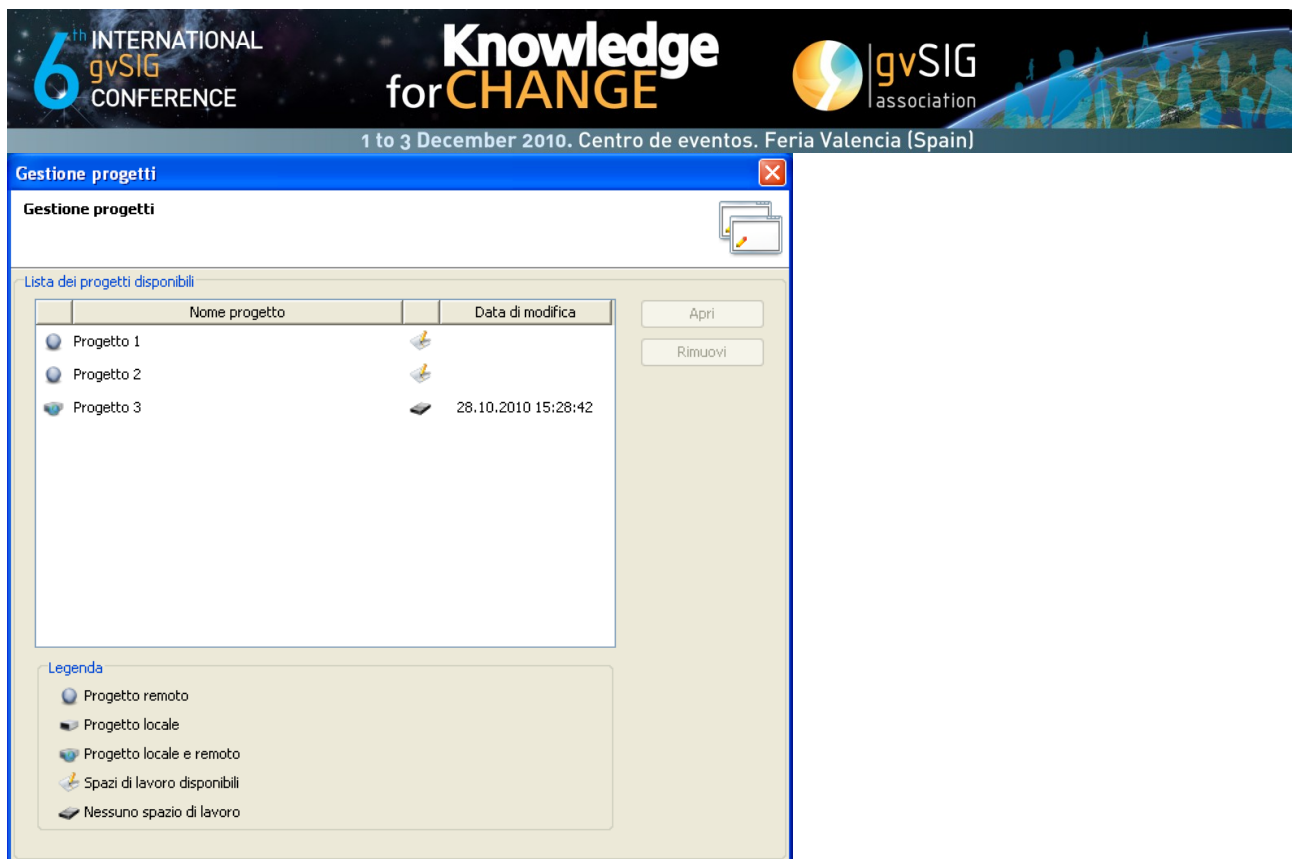


Figure 3: Project Manager Dialog

After a Project has been opened, gvSIG will load all the layers defined in the Project.

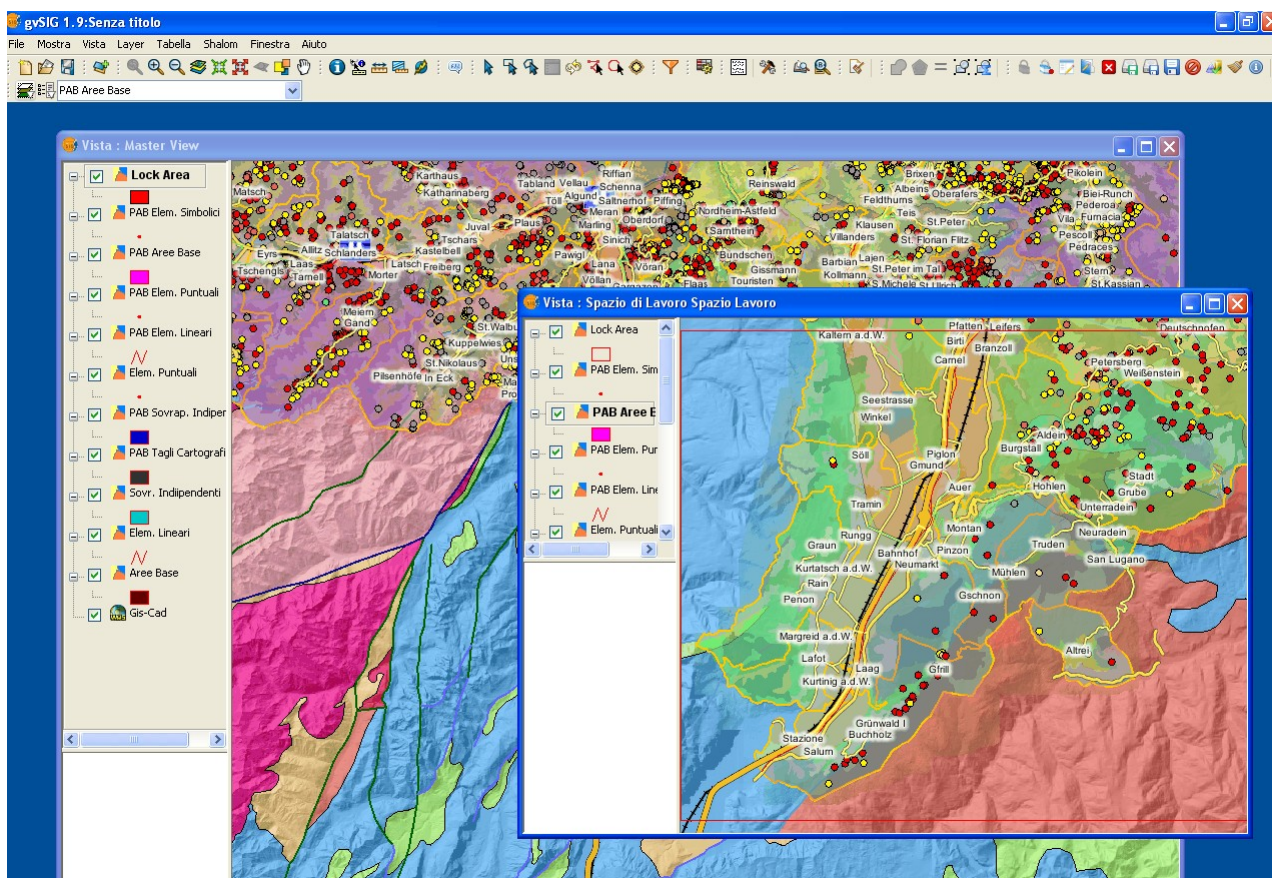


Figure 4: geneSIG with Project and Workspace loaded

In the Project's View the user can create his Workspace (Lock Area) or open existing ones, always depending on his permissions on the Project.

Attribute Tables - Permission Management

Attribute Tables are used to change the value of attributes:

- Attributes are displayed in red color if the user has no right to edit the value (read-only)
- No actual value but a custom message is shown if the user has no right to read the value
- Input Validation Rules are applied according to the pre-configured datatype

Tabella: Tabella degli attributi: PAB Aree Base

PK_ID	CODE	UNA_DATA	NOTA_IT	ISTAT_CODE
3174	1	2010-02-01 ...	ita ita	ITALIANO 1
-127781476...				

Figure 5: Attribute Table with customized colouring

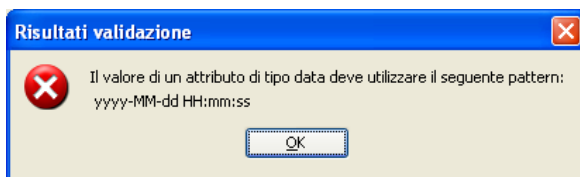


Figure 6: Input Validation Rules Message

Attribute Tables - Look-Up Values

Attribute Tables are used to change the value of attributes. This is also the case if the attribute is a look-Up attribute.

Attributi: PAB Aree Base

ATA	NOTA_IT	ISTAT_CODE
01 ...	ita ita_MOD	ITALIANO 1

Figure 7: Attribute Table with Look-Up Value

Modifica valore attributo di look-up

Modifica valore attributo di look-up

Nome dell' attributo
ISTAT_CODE

Lingua di editing per l' attributo
italiano

Valori ammissibili
ITALIANO 100

Modifica attributo Annulla

Figure 8: Look-Up Value Dialog

Topology Errors

Topology Errors are shown in the Topology Errors Dialog. The Topology Errors Dialog contains all topological errors returned by the newGIS validation when spatial data is saved remotely.

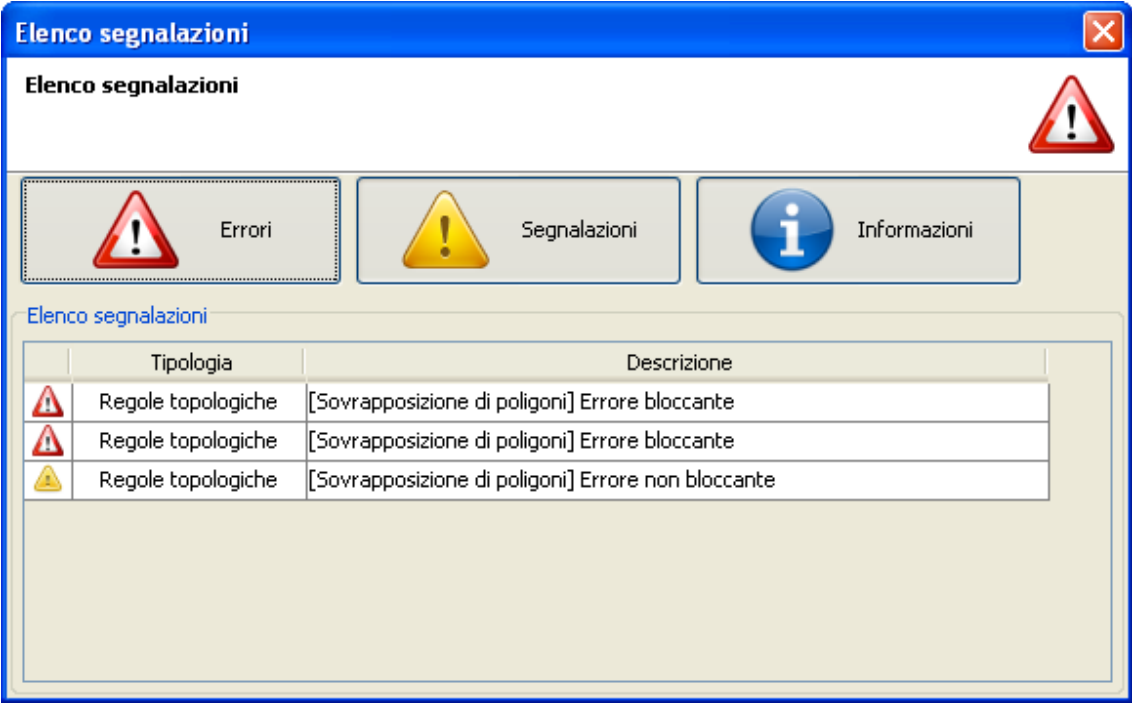


Figure 9: Topology Errors Dialog

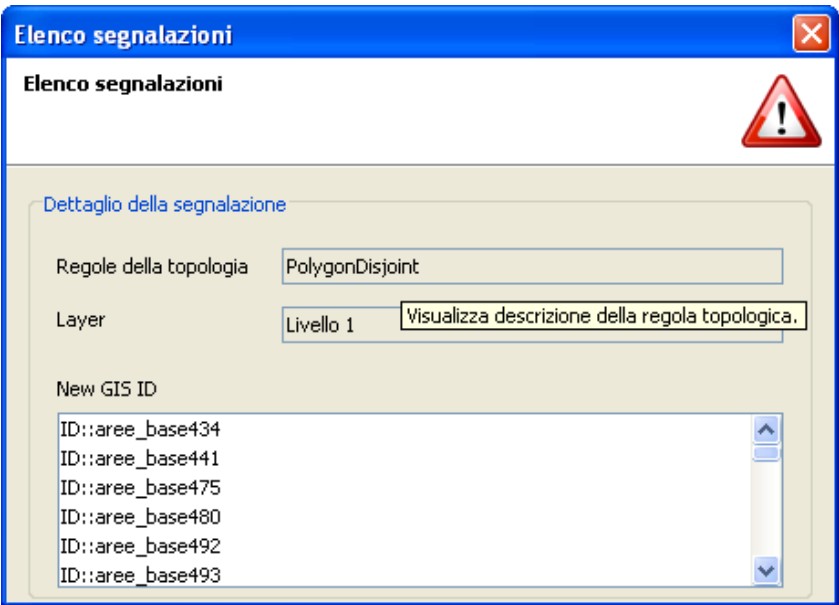


Figure 10: Topology Errors Dialog with detailed error information

Topology Rules can be defined between one or more layers.
Topology Rules errors can be of type blocking or non-blocking:

- Blocking Errors
 - If a blocking error is thrown the update process of the spatial data is halted. An appropriate error is returned.

- Non-Blocking Errors
When a non-blocking error occurs, an appropriate error-message is returned, but the user can choose to continue the update process.

For Topology Rules between two layers it is possible to define a blocking strategy for each direction: e.g. a topology rule that is blocking from layer A to layer B but not-blocking from layer B to layer A.

newGIS Services

Some newGIS Services have been integrated in geneSIG, e.g. services for spatial data manipulation or spatial queries.

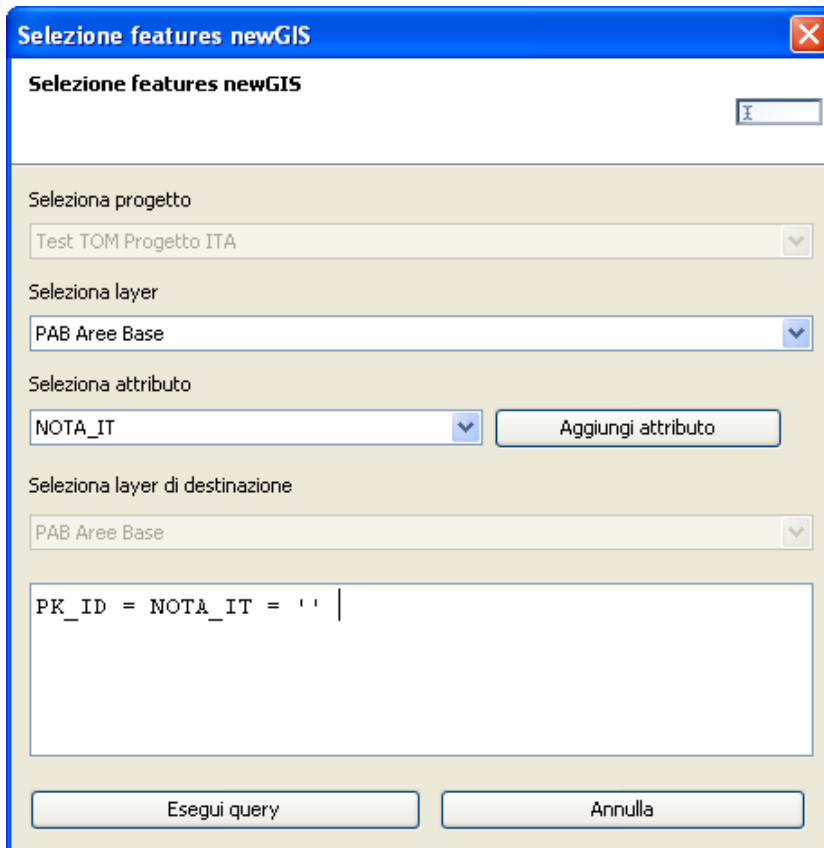


Figure 11: Query Builder Dialog

The Query Builder executes spatial queries remotely on the newGIS system. The query is not executed as SQL directly but through a WebService after passing the authorization module.

Problems developing with gvSIG

The major problems that occurred while developing with gvSIG:

- Some classes of GeoTools had to be fixed so that correct GML could be generated from ORACLE SDO_Geometry
- Definition of the modularity so that reload of geneSIG modules and live update were possible
- Use of gvSIG listeners instead of direct changes to the gvSIG GUI
- Some classes in gvSIG don't use interfaces for accessing methods but use casting objects to real classes instead (e.g. DefaultRowEdited instead of IRowEdited, FLyrVect/FLyrDefault instead of IFLayer). This caused that some classes had to be extended instead of implementing the right interfaces.

5. Conclusions

The main result of the personalized gvSIG in the form of the geneSIG client application is a useful newGIS Infrastructure client, which allows using server-side GIS functionality with a familiar and true GIS client at no additional license costs.

The Autonomous Province of Bolzano also plans to use gvSIG as the "Standard-GIS-Client" within the public administration. gvSIG shall substitute ESRI clients (ArcView 3.x/ArcGIS ArcView 9.x) currently in use.

The Autonomous Province of Bolzano is very interested in contributing source code of corrections, improvements and extensions of gvSIG to the gvSIG Association. At the same time the Autonomous Province of Bolzano has to be sure that those contributions become part of official subsequent releases or at least, must have the guarantee that these developments remain compatible with future releases of gvSIG.