

GEOSISMO: Visualization of Events and Seismologic Characteristics in the Internet

Manso Callejo, Miguel Ángel (MS)¹

Maldonado Ibáñez, Ana (MS)²

Hernández Rey, Román (BS)³

Ballari, Daniela (MS)⁴

Moya Honduvilla, Javier (BS)⁵

Grupo de Investigación MERCATOR

Departamento de Ingeniería Topográfica y Cartografía

Universidad Politécnica de Madrid (Spain)

{m.manso¹, a.maldonado², r.hernandez³, daniela⁴, j.moya⁵}euitto.upm.es

Abstract: *An inventory of seismic movements at global level exists that is based on the data gathered by the seismographers of each observatory. This inventory includes the location and characteristics of the technical equipment of the observatories, as well as the location and date of each earthquake. The inventory is stored in an Access database, and the accelerograms (temporal series of accelerations) are stored in text files. It is proposed that a web service based in a Web Feature Service be created, following the specifications of the OGC (Open Geospatial Consortium), that would visualize the location of the seismographers and of the epicenters of the earthquakes for the spatial and temporal intervals provided. The representation of the places will be a geometric symbol proportional to the PGA magnitude, based on information extracted automatically by the system. When the context (number of elements to represent or zoom level) permit it, the accelerograms will be visualized as scaled in proportion to the magnitude of seismic activity instead of as a geometric symbol. This type of visualization will facilitate interpretation and a rapid decision when the page is consulted. This objective will be enhanced by the possibility of visualizing the information from anyplace that has Internet access, because the tool will be configured as a piece of SDI in conformance with OGC standards.*

1.- INTRODUCCIÓN

New methodologies in the management and storage of spatial information have been started with the advent of the Geographic Information Systems. This type of technologies, in addition to allowing us to jointly handle cartography and the associated alphanumeric databases, it offers us the possibility of analysing them and generating a new cartography on the basis of the results obtained; nonetheless, in spite of the advancement the GIS meant in their day, they present disadvantages to be taken into account. In the first place, their lifespan is limited since they are conditioned by the temporal nature of the data utilized in their development, i.e. it is neither easy to maintain these systems updated with the latest available information nor the update is automatically carried out. Nor are the datasets usually shared by other organizations, which, in addition, are difficult to export among the different systems. Here the Spatial Data Infrastructures (SDI) become vitally important indeed, turning into an indispensable tool to solve the above-mentioned problems, thanks to the implemented policies and the observance of their regulations and specifications. Furthermore thanks to the increase in participants involved in data collection and distribution, the non-redundancy of information in various formats among different organizations is facilitated, and every user may get the latest updates of the data of his/her interest almost in real time, only depending on the version most recently saved by the server from whom the data to be used are being obtained.

On the other hand we realize that these advances may be extrapolated to diverse fields; we are focusing on a component part of seismology. At present, seismographs record earthquakes in accelerograms; the appearance of these graphic records depends on the distance from the seismograph to the epicentre, its magnitude and depth and the type of instrument used. At the present time it is difficult to maintain a database updated with the accelerograms recorded by the different stations in any part of the world; this hinders a quick intervention in the event of a natural disaster, evacuations, evaluation of damages or injuries or the organization of humanitarian aid according to the importance of the catastrophe. This is solved by the incorporation of SDI's as a work tool, since by being able to share information with any server in any part of the world, we will always work with the latest records obtained by the seismographs, thus facilitating tasks of aid, planning or rescue.

GEOSISMO emerges as a solution to the previously mentioned problems. With this application we intend to have a web service available in accordance with the Open Geospatial Consortium (OGC) specifications that will allow visualization of seismograph locations as well as the earthquake epicentres for a given spatial and temporal interval. All this will be done starting from an inventory of seismic movements and temporal series of the accelerations stored in databases and text files respectively.

Geosismo generates a response to the user's textual or image requests, related to earthquakes or it manipulates them so as to make them understandable to other servers, thus taking advantage of the data these servers have, and using them again as a response to the user's initial request. Geosismo also allows the transactional insertion of new seismologic phenomena. This way Geosismo turns into a dynamic tool, therefore a much more useful tool, giving the option of carrying out different operations with the latest updated data online. The representation of the stations will be a geometric symbol proportional to the magnitude. This data will be automatically extracted by the system. In addition, as the context allows it (number of elements to be represented or degree of zoom), the accelerograms scaled proportionally to the magnitude of the seism will be visualized instead of the geometric symbol.

This will facilitate the interpretation and decision-making at the moment in the event of a query. The above-mentioned problems will be solved to a great extent.

2.- INFORMATION PROCESSING

We start from an Access database with information associated to earthquakes and the seismographic stations recording them. We will turn it into a PostGis database which we will prepare for the realization of eventual queries, insertions or data updates through the server.

We also prepare a map server, specifically MapServer, to dynamically produce maps from georeferenced geographic information. This service will be used by the wrapper built into Geosismo to make sure that the accelerograms and point symbols are shown. The wrapper generates queries on the WFS and defines a query with user's style to be processed by MapServer.

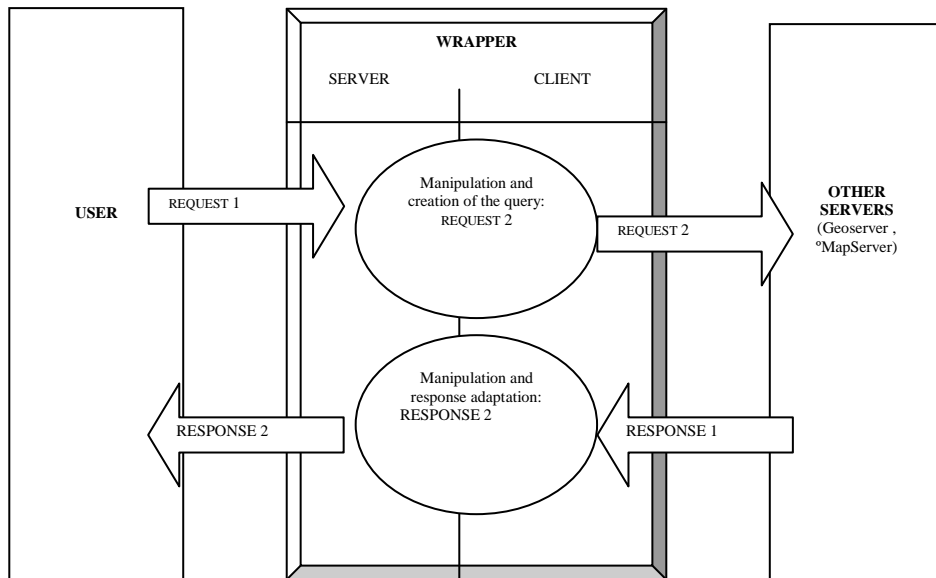
Finally, the Web Feature Server (WFS) is prepared. We chose Geoserver for integration into the wrapper. This server will allow the user to query and retrieve vectorial geospatial data from multiple Web Feature Servers, using the Internet as a platform. This move will allow access to the actual data, geographic features, data queries and support of transactional operations, chiefly insertions.

3.- MODELLING OF THE VISUALIZATION SERVICE WITH A WRAPPER

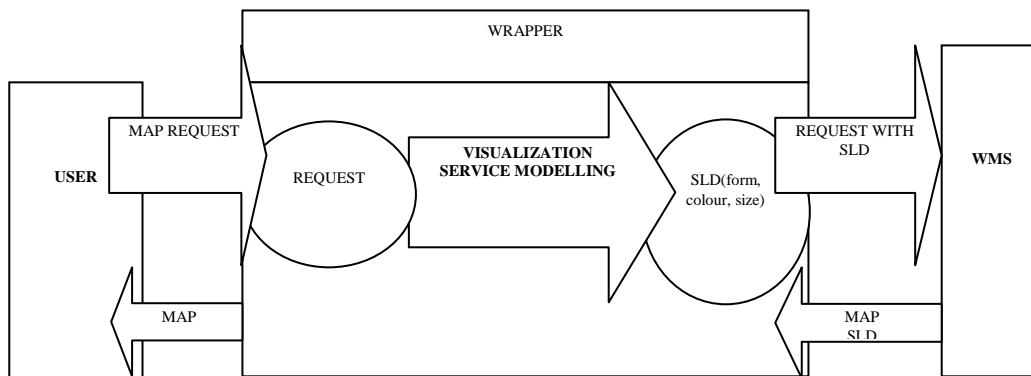
What is a wrapper? It is a service of a hybrid nature (server/client). It acts as a server in front of a user and as a client in front of another server to whom, in turn, it makes requests.

In the case of Geosismo, the stages are:

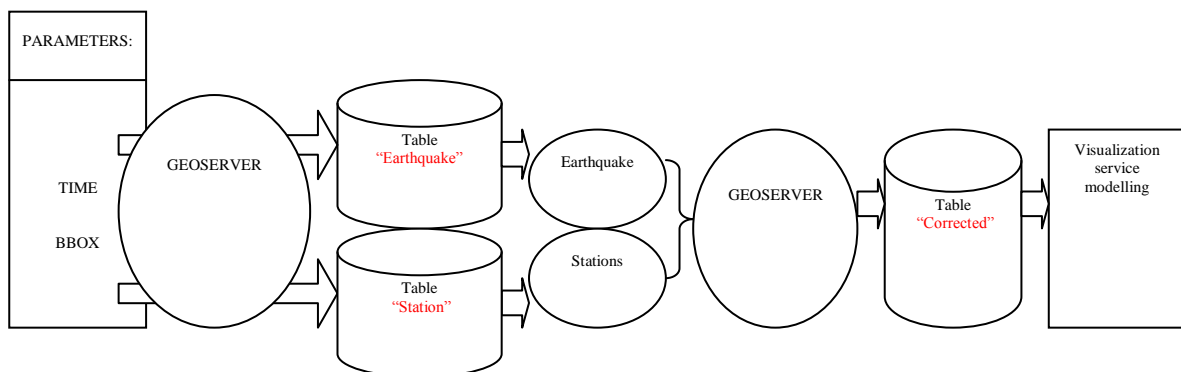
- 1st.** As a server, the user makes a text or image request about seism information.
- 2nd.** As a client, it manipulates the request he/she makes to other servers (Geoserver and MapServer) on the basis of the request the user has made.
- 3rd.** As a server, it responds to the user with information (images or text) from those servers, and with information generated by it.



Modelling of visualization service with a wrapper. The wrapper generates the visualization of the seismic map according to certain parameters. From these parameters, the wrapper's client component queries the different servers. With the collected information, it carries out the **modelling of the visualization service: colour, form, size...** of every symbol. This action creates the SLD document wherewith the request will be made to the WMS in order to produce the map in conformity with the user's request.



Relationship between Geosismo and Geoserver. Geosismo is interrelated with Geoserver so as to extract information about the features corresponding to the parameters introduced by the final user:



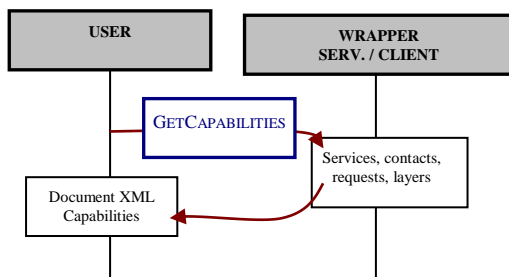
4.- IMPLEMENTATION

The tool has been developed in JAVA programming language. We interrelate Geoserver, as a Feature Server, and MapServer, as a Map Server, with our wrapper. For requests to the servers we must use a common language standardized by Open Geospatial Consortium specifications. In our case, through the generation of different classes and functions, we create XML documents to carry out requests by the POST method, whereas the GET method is used for obtaining images, sending the request through URL. Next the requests carried out by the tool are described for the servers as well as the schemas of the requests for their better comprehension by the servers:

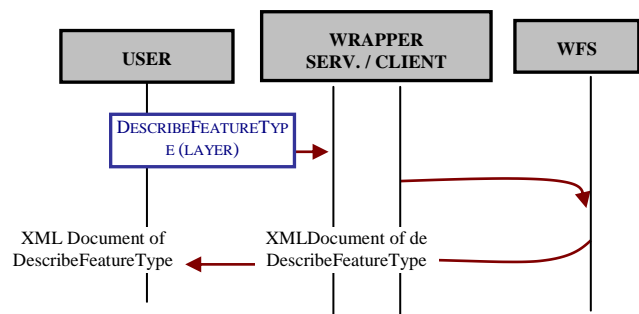
- 1) **GetCapabilities.** It returns the server's capabilities. The capability file will describe what the map server is capable of doing, what operations it supports, what input and output formats it accepts and what information layers it offers. This way the users will be able to decide whether the server's data fit their needs and how to access them in the event they decide to use them.
- 2) **GetMap.** By carrying out this request, the server will send as a response an image in conformity with the specified parameters, namely: TIME, COMP, BBOX, WIDTH, HEIGHT, FORMAT, LAYERS, IMAGE.
- 3) **GetFeatureInfo.** Depending on the layer and position indicated, the server will return the record information stored in the database. The parameters for this request are: BBOX, WIDTH, HEIGHT, X, Y, COMP, TIME, LAYER.
- 4) **DescribeFeatureLayer.** This request returns the layer description from a sole parameter: LAYER.
- 5) **GetFeatureImage.** In this case we should highlight the fact that we are dealing with a proprietary implementation. From the parameters BBOX, WIDTH, HEIGHT, X, Y, COMP, TIME, LAYER, we carry out another request to the server. Thus the server will return the feature symbol for the layer and position as indicated.

The schema is presented below:

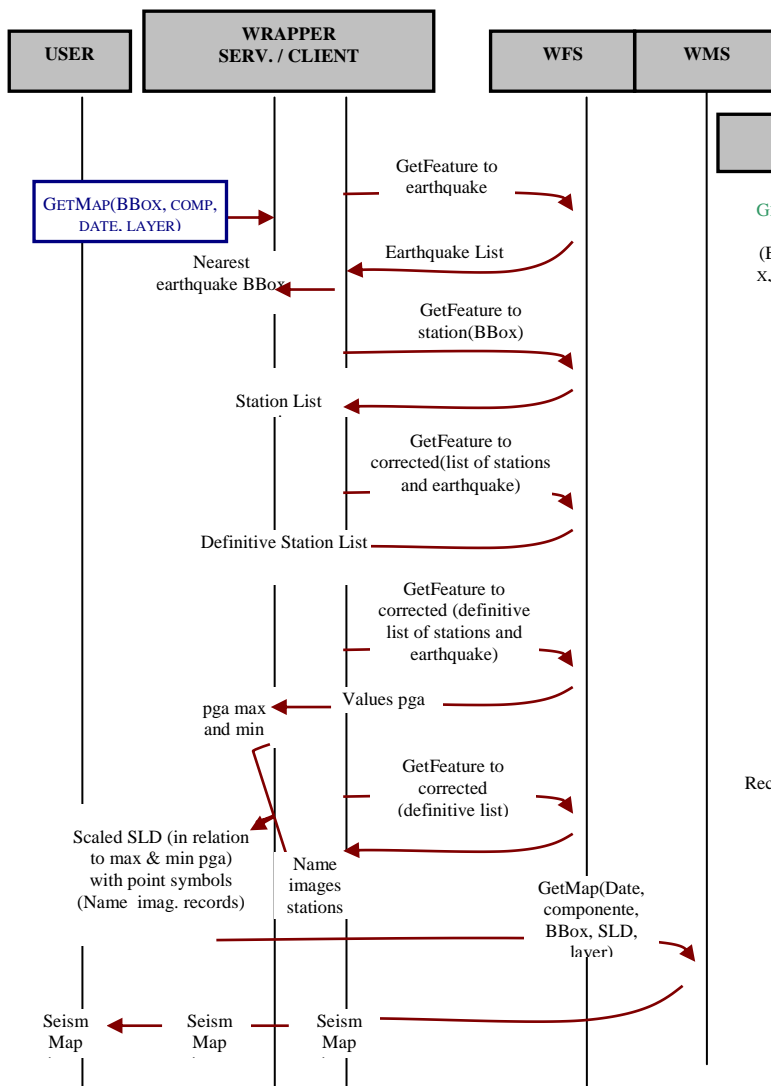
1 – REQUEST GETCAPABILITIES



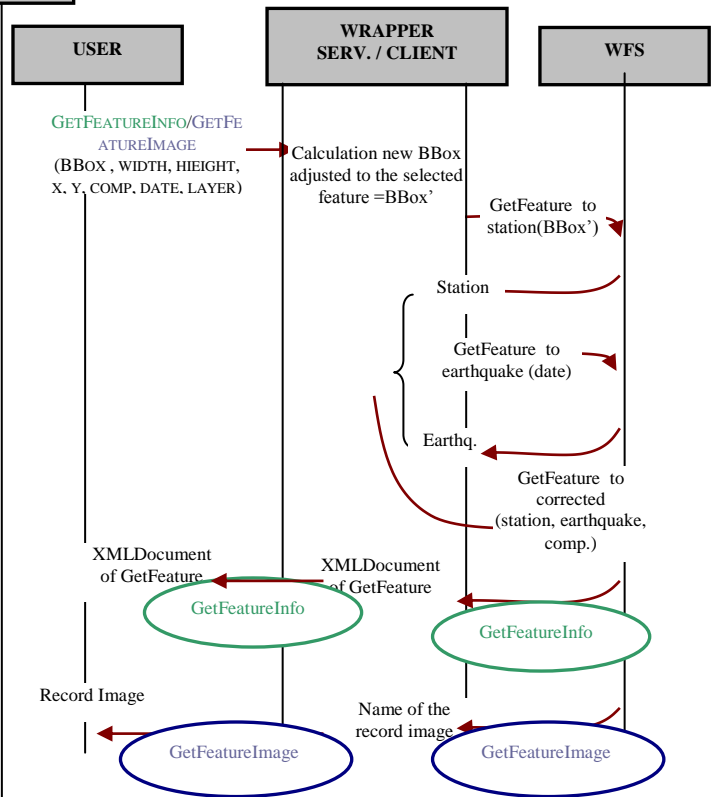
3- REQUEST DESCRIBEFEATURETYPE



2 - REQUEST GETMAP



4/ 5 - REQUEST GETFEATUREINFO AND GETFEATUREIMAGE



Transactional operations are also ready to be carried out through requests to the Feature Server with instructions through the Internet. A WFS may directly process a transactional operation; it also has the possibility of translating it into the language of a certain data store, executing the operation from it. As the operation is completed, the WFS will generate a XML document as a response, indicating the result of the operation. In our case only insertion has been utilized as transactional operation which has been created with the aim of adding new records on the database.

The insertion of images to be utilized by the tool (accelerograms) will be stored using this procedure in two different ways:

- 1) If the browser used is Internet Explorer, the images will be stored in a directory. Only the route of access to the images will be stored in the database.
- 2) If any other browser is used, the images will be stored directly in the database, so that the images will be coded in Base 64 and they will be saved as a binary code character string, facilitating their manipulation and operations. In this manner, room is saved when storing the images and a more compact data structure is made available.

5.- RESULTS FROM THE POINT OF VIEW OF VISUALIZATION

Thanks to the operations carried out, the tool offers us results that may be of interest from the point of view of visualization as follows:

- 1) Scaled point symbols when the number of stations registering an earthquake is greater than 6 in the BBOX.
- 2) Accelerograms as proportional symbols when an earthquake is registered by less than 6 stations.
- 3) The colour of the symbols used is different depending on the value of the associated PGA (positive or negative).

6. – CONCLUSIONS

The aptitude of SLD for the creation of point symbols in the production of thematic maps and point symbols is shown.

These symbols are individually represented through filters by means of external images, an image for each symbol, so that a SLD document is dynamically created wherein each feature has an associated different image route. In addition, these images may be scaled on the basis of any parameter, as is the case for the PGA. Here the quality of visualization will above all depend on the quality of the external image.

In the case of SLD, point symbolization of its own (without external image), feature individuality for the production of thematic maps is also possible, since the style of symbol representation of each point is modified: form, colour, scaled size, etc.

The only disadvantage in the application of SLD for obtaining point symbols is the impossibility of defining a displacement for each symbol in relation to its feature. This implies a symbol overlapping when the features are very close.

This would be solved by a parameter of displacement in SLD point symbolization, such as is the case in text symbolization. From an algorithm analysing feature distribution, the needed displacement for each symbol can be calculated, thus avoiding overlapping.

Work perspectives for the future:

We intend to continue working on this project in order to improve map visualization and make their interpretation easier. For the time being, the following lines to be developed to achieve such an improvement would be:

- 1) Whenever the stations recorded very low PGA values, these would be considered negligible and their images would not be shown. They would not contribute any useful information and this decision would not have any negative repercussion in map interpretation.
- 2) For better map visualization, we will work on the symbols used by the tool in Scalable Vector Graphics (SVG) XML-based language for description of bidimensional vectorial graphs.

REFERENCES

1. Open GIS Consortium Inc.(2002): Styled Layer Descriptor Implementation Specification. Reference number of this OpenGIS® Project Document: OGC 02-070. Version: 1.0.0.
2. Open GIS Consortium Inc.(2001): Filter Encoding Implementation Specification. Reference number of this OpenGIS® Project Document: OGC 02-070. Version: 1.0.0
3. Open Geospatial Consortium Inc.(2002): Web Map Service. Reference number of this OGCTM project document: OGC 04-024. Version: 1.3
4. The IDE Cookbook. Version 2.0 25 January 2004.
5. Open GIS Consortium Inc. (2002): Web Feature Service Implementation Specification. Reference number of this OpenGIS® project document: OGC 02-058 Version: 1.0.0