	**WebPark** **IST-2000-31041** **Geographically relevant information for mobile users in protected areas**

GI interoperability platform - Webmapping D3.1.1.

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Abstract:

This document focuses on the step of choosing and developing a webmapping application. The first chapter briefly explains the webmapping concept. Then a description of the most important standard (OpenGIS Consortium) is given. In Chapter 4, three different and popular webmapping tools are evaluated and compared. As a result of this evaluation, one webmapping tool is proposed and described in detail.

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1. Introduction

WebPark is going to be an Internet deployed application. With a simple click, the users can see their surroundings map, find the closest point of interest or get driving directions to their next destination. And flower lovers can visually spot the location of a rare species in their neighbourhood. So it is important to always have the most updated data available.

Having the data on the servers allows central control of it, overcoming the problems of updating the data in all the devices that run WebPark service (if the data was stored locally). For these reasons we need to develop or choose an interoperable webmapping application.

This document focuses on the step of choosing such a tool. The first chapter briefly explains the webmapping concept. Then a description of the most important standard (OpenGIS Consortium) in this field is given. In Chapter 4, three different and popular webmapping tools are evaluated and compared. As a result of this evaluation one particular webmapping tool is proposed and described in detail.

2. Webmapping

Webmapping is the general term for viewing and retrieving spatial data (maps) through the Internet. Basically, this means that a user can view a map of a certain area through the web in a browser.

The data (or map layers) that are reflected on the map, are stored at the server anywhere in the world. Buttons on the screen of the browser allow you to execute several GIS-operations on the map, such as zooming in and out, or acquiring information about certain elements on the map.

Hereby webmapping may partly take the role of the present 'stand-alone' software, especially where the not-too-heavy GIS applications are concerned, like large processing as spatial data modelling. Webmapping can replace stand alone GIS when visualization is the main goal.

The different GIS software is then replaced by a sole central Webmapping server, accessible to everyone with access to the Internet through a simple web browser.

For WebPark, the webmapping solution will have to be a mobile one. Mobile webmapping shares the same concepts as traditional webmapping, but the maps are accessible through mobile devices. The procedure of retrieving the maps is similar, the devices connect to the Internet (through GPRS/UMTS) and make a request to the server for a map. The difference is on the client side, since the target devices have more limitations, for example, the screen size is smaller, JAVA may not be present, and computation capability on the client side is lower than in traditional desktops. For this reasons it is intended in mobile webmapping to shift the computational work more to the server side, also the map size has to be taken into account, dimensions and file size because of the limitations within the bandwidth.

2.1 Advantages of webmapping

Webmapping has a number of important advantages:

Simple distribution: As an Internet application web mapping renders the acquisition and installation of unnecessary GIS-software and GIS-data on devices. With a basic browser users can view and edit data from their devices. It is assumed that all users have a standard Internet connection at their disposal.

Central management: All users view the same centrally stored data. With the traditional GIS systems the problem often arises that several sets of data copies are stored, which all require managing and updating from time to time. In a centrally managed data set these updates take only a matter of minutes.

Combining of geo-information: The geo-information of different suppliers may displayed through one single application.

Simple implementation: Existing systems and data formats may be maintained.

Contracting: The possibility to spread costs and maintenance by leaving data at the provider, who will then take care of maintenance and updates. In this way, maintenance of the data is the provider's concern while the application has always access to the latest data.

2.2 Implementation

The concept behind webmapping is quite simple, but its implementation is not. There are some considerations to take into account:

Technology: Suppliers of conventional GIS-systems are reacting to the demand of "Internet-GIS" by developing techniques that make their data available through webmapping. The result is a whole range of webmapping tools of varied kinds. The choice of one technique or another determines the look, the performance or the functionality, and it is therefore of

importance to be well-informed.

Management and hosting: On a webmapping service implementation, it can be decided on who is to manage the application and where is it hosted. It is possible, for example, to add a page with map-functionality and put this under the responsibility of one of the partners (management and hosting), while others manage the rest.

3. Standards

Standards are important because a lot of geospatial data is available on the web and in off-line archives, but often it is complex, heterogeneous, and incompatible. Users must have considerable expertise and special geographic information system (GIS) software to overlay or otherwise combine different map layers of the same geographic region. Data conversion is cumbersome and time-consuming, and the results are often unsatisfactory. Common interfaces are the only way to enable overlays and combinations of complex and essentially different kinds of geographic information to happen automatically over the Internet, despite differences in the underlying GIS software systems.

3.1 OpenGIS

OpenGIS Consortium (OGC - http://www.opengis.org/) brings together the key players in the geo-information world and provides a formal structure for achieving consensus on the common interfaces.

OpenGIS is defined as transparent access to heterogeneous geo data and geo-processing resources in a networked environment. The goal of the OpenGIS Project is to provide a comprehensive suite of open interface specifications that enable developers to write interoperating components that provide these capabilities. [1]

The architecture of OpenGIS Web Services is illustrated in Figure 1. The OpenGIS architecture makes it possible to combine information layers from various sources and integrate them seamlessly, regardless of native data formats and communication technology between components. This makes it possible to replace components of the solution without changes to the solution architecture and code. The open specifications establish:

- How maps can be stored, transferred and exchanged;
- How mapping components need to be designed to make them interoperable and plug-and-play
- How information needs to be documented and associated to metadata for easy and effective retrieval.

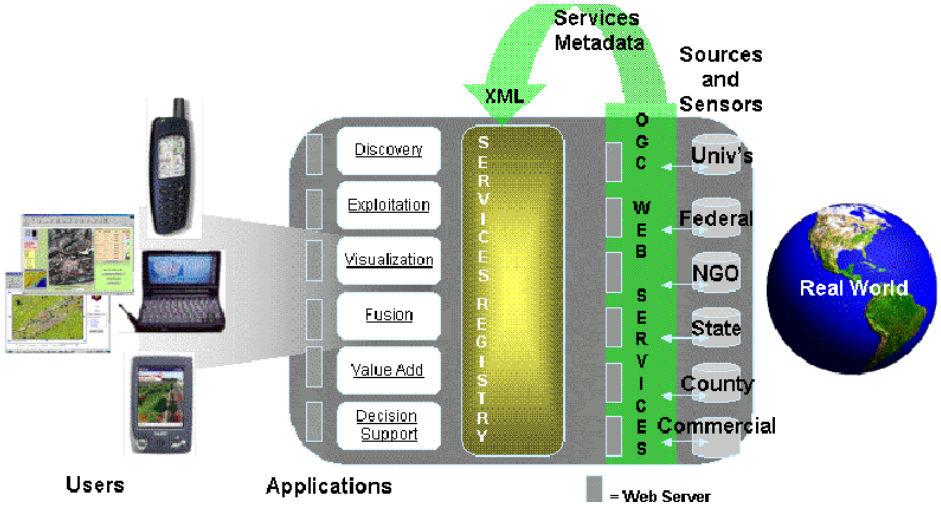

Figure 1 OpenGIS Web Mapping

Web Mapping is based on the identification of a mapping server through a URL specified by a

series of parameters. Standard parameters include a map request or a capability request. Additional parameters include:

- Height and width in pixels;
- SRS (Spatial Reference System, or coordinate system).
- Bounding box
- Layers to be displayed
- Styles of display
- Graphical format (GIF, SVG, ..)

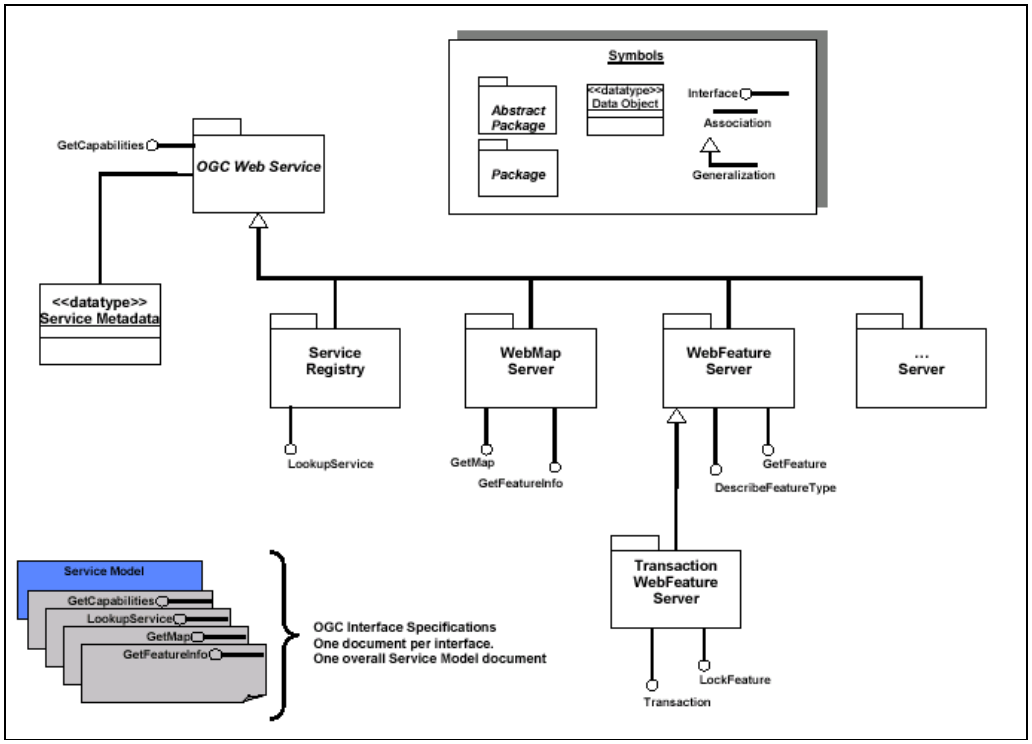

Figure 2 OpenGIS web services. Service layout.

4. Webmapping options

After an initial research, we decided to focus our investigation on 3 well recognized commercial of the shelf (COTS) products, MapSwing, ArcIMS and MapXtreme.

4.1 ArcIMS

Product developer: ESRI, USA.

ArcIMS provides the foundation for distributing high-end geographic information systems (GIS) and mapping services via the Internet. ArcIMS software enables users to integrate local data sources with Internet data sources for display, query, and analysis in an easy-to-use Web browser. [3]

Standards-based Communication - ArcIMS clients and servers communicate using ArcXML, which is a GIS extension to standard extensible mark up language (XML). ArcXML also offers an easy, yet powerful, way to customize ArcIMS applications.

4.2 MapXtreme

Product developer: MapInfo Corporation, USA.

MapInfo MapXtreme Java Edition is specialized for Internet deployment of applications. When developed using a Java development environment, MapXtreme Java applications can be migrated and reused regardless of future hardware or platform choices. MapXtreme Java follows the J2EE specification so developers can deploy applications with the tools provided or migrate to another J2EE compliant application server. [5]

4.3 MapSwing

Product developer: Geodan b.v., Netherlands.

Geodan has developed a high-performance Web Mapping Server (WMS) based on Java, with which the most usual GIS and database formats can be opened up in any required projection. The WMS is designed according to the most advanced OpenGIS specifications. At the same time a highly interactive lightweight Java client has been developed to which a users-interface may be set up. This can be tailored to the functional demands of the specific application.[6]

Standards: Benefit from the OpenGIS standard, XML and Java for ‘open’ webmapping in which you are independent of specific formats or providers.

4.4 Performance comparison

4.4.1 Test parameters

A research was done to test and compare the performance of MapSwing, ArcIMS and MapXtreme. The performance of the server was the only parameter tested because in the WebPark framework it is the only parameter that is settled, we have not decided yet on the other technical architecture details, like the delivery platform (rendering or portrayal).

Table 1 Parameters and values for the comparison test between mapping tools

Parameters tested	**Value**
Machine webserver	650 Mhz
Processor	Pentium III Dual Processor
Internal memory	1 GB
Operating system	Windows 2000 Server
Web server	Apache 1.3.12
Intranet connection	10 Mbps
Image	Eurostreets®, Paris, most detailed level
Image colours	24
Requested image	Eurostreets®, part of Paris
Requested image size in pixels	400x400
Test program	Python script: requests 10 images and averages this to "requests per second"

Figure 3 Image used for the comparison test

4.4.2 Results

The results can be summarized in the following tables 2, 3 and 4:

Table 2 - Performance of Geodan's OGC WMS as Apache Module

mod_sclmapserver.dll				
Image format	*ECW*			
Image size on server	*12*	MB		
Image format	*JPG*	*PNG*	*GIF*	
Image size in bytes	35608	*21922*	*21676*	
Speed on client	*2.27*	2.44	2.33	requests per seconds

Table 3 - Performance of Geodan's OGC WMS as CGI

SclMapServer.exe				
Image format	*ECW*			
Image size on server	*12*	MB		
Image format	*JPG*	*PNG*	*GIF*	
Image size in bytes	35608	*21922*	*21676*	
Speed on client	*1.66*	1.95	1.99	requests per seconds

Table 4 Performance of ArcIMS 3.1, using the com.esri.wms.EsriMap wrapper, delivered with the product.

ArcIMS 3.1				
Image format	*Uncompressed TIFF*			
Image size on server	*120*	MB		
Image format	*JPG*	*PNG*	*GIF*	
Image size in bytes	46713	*31399*		
Speed on client	*1.01*	0.96		requests per seconds

Table 5 Performance of MapXtreme for Java 3.1, using the MapXtreme HtmlEmbeddedMapServlet, delivered with the product

MapXtreme for Java 3.1				
Image format	*GIF*			
Image size on server	*4.6*	MB		
Image format	*JPG*	*PNG*	*GIF*	
Image size in bytes			*18608*	
Speed on client			0.55	requests per seconds

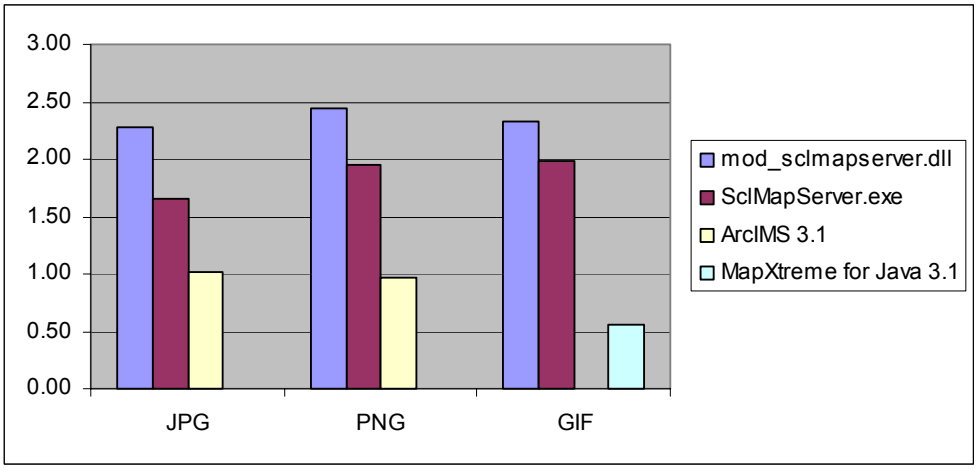

Figure 4 The graphical and aggregated results of the performance comparison of the 4 webmapping options.

4.4.3 Conclusion

Geodan's mod_sclmapserver, the Apache version of SclMapServer, can handle the most requests per second, it has the best performance. MapXtreme showed the worst performance. Although the testing was made just with raster data, it is a good indicator of the tools capability.

5. Proposed Webmapping tool

On a previous WebPark report, "*wpk-3100_d311_OpenLS_OGC_comparison_v01.doc*", it is stated on the recommendations section to "*Use OWS (WMS, WFS, SLD, GML) to provide access to data services*".

Because MapSwing complies with the OpenGIS Web Services Specifications [1] and demonstrated the best performance on the test, we propose the use of MapSwing as the webmapping tool in the development of the WebPark services.

During the development phase it will be discussed which components of MapSwing to use.

The description and technical details of MapSwing are available in Annex.

5.1 Note and further amendments:

At the time of the creation of this report, the cartographic needs and other technical requirements were not determined and agreed in the WebPark Consortium. This is the reason they were not included in the selection criteria. Needs for rendering and portrayal have to be determined and the webmapping evaluation should consider these requirements, once important factors that affect the performance

This report is supposed to be considered a proposal and a base of discussion, rather then a decided step. It may be amended in the future, if the project benefits from the change.

6. Prototype of the recommended tool

To illustrate the use of the proposed webmapping tool, a prototype was built and tested on a mobile client (iPaq from Compaq).

The prototype-client has the following tasks:

- retrieve the images from the server, according to the OGC WMS specifications;
- display the images;
- zoom and panning functionality and map calculations (pixel-coordinates to display the map, and world-coordinates to retrieve the images);
- adding/removing/reordering layers (can be added).

It is possible also to connect to a Web Feature Server to retrieve coordinates in vector format and display them on top of the raster images of the Web Mapping Server.

The servlet solution (or SclMapServlet as it is called) is a client for an OGC WMS server, and generates plain html or wml. No applet or JavaScript at the client side is needed. It makes use of the “ismap” - attribute of an image (available in both normal as micro-browsers).

This prototype consists of two components:

- the servlet-part: which manages all layers, builds the images, writes requests to jsp/html pages, etc
- jsp-pages: the actual web pages, in which the servlet calls are incorporated.

Every action generates a new page (which in turn request for a new map image). There is no local or temporary saving of the map images on the web server. When a map request is received, images are requested via the OGC WMS server, they are combined (also giving possibility to draw something ‘extra’ on it) and sent to the client (where the client is actually nothing more then a html-page with a <img> tag in it.

The servlet is best suited for simple but consistent web mapping web applications: viewing of map images, panning and zooming in all browsers (none or almost no JavaScript and no client side Java or plugins are needed), which meets the requirements of mobile mapping. Besides that, it is possible to send mouse click positions to the servlet, to make some web mapping tools (e.g. in response the servlet can generate info about the location being clicked at).

Exploration of the prototype

The prototype can be accessed from the URL:

http://212.203.18.164:8080/mapservlet/sclmapservlet

To explore the prototype, insert the above URL address on your browser (can be a wireless device with internet access and windows CE). On the top, and occupying most of the screen, the user can access a dynamically created map from the Swiss National Park Area. He can zoom in/out, pan (by clicking in the arrows buttons or on the map the to recenter). This prototype uses raster and vector data simultaneously in different layers. After an appropriate level of zooming it is possible to view the POI’s labels (vector data).

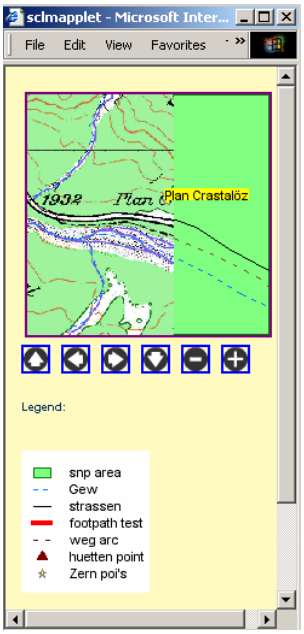

Figure 5 Prototype GUI.

7. References

[1] – OpenGIS consortium, Inc. (OGC)
http://www.opengis.org/

[2] – Dictionary online
http://www.dictionary.com/

[3] – ESRI – ArcIMS
http://www.esri.com/software/arcims/index.html

[4]ISO/IEC 2382 Information Technology Vocabulary (ITV)

[5] - MapInfo® MapXtreme® Java™ Edition
http://www.mapinfo.com/mapxtreme/

[6] – MapSwing from Geodan
http://MapSwing.geodan.nl/

Annex 1 Description of the proposed webmapping tool

MapSwing has two main components: the server side (SclMapServer) that contains a web mapping server and a web feature server, and the client side that can be implemented for browser clients or for Windows based stand-alone clients. All communication is based on HTTP, XML and GML.

For the WebPark project, the browser-based solution is proposed. The only requirement to the user is a browser with basic Java support, a standard feature of all commercial browsers (Explorer, Netscape, Opera).

Server

The server is written in C++ and makes use of the SCL (Spatial Component Library), a library of geographic functionalities developed by Geodan. MapSwing has two major implementations:

1. CGI under Apache, IIS, Oracle IAS and many other web servers
2. Apache module under Apache

The main tasks of the map server are:

- Web Mapping Server
- Web Feature Server
- Transactional Web Feature Server (inserts, updates en deletes)
- Geocoding through Web Feature Server

Client

Three major clients are implemented:

- Java: Applets (Mapplets) that can be called by the web pages.
- Delphi: off-the-shelf clients or components library for constructing applications that work with OpenGIS Web Mapping. These components are clients for both the Web Feature and the Web Mapping Servers.
- JavaScript: a small client that, without Java, manages web mapping (Web Features are not supported)

Before the end of the year 2002, the following clients will also be released:

- ·.NET
- MacroMedia Flash
- Pocket PC

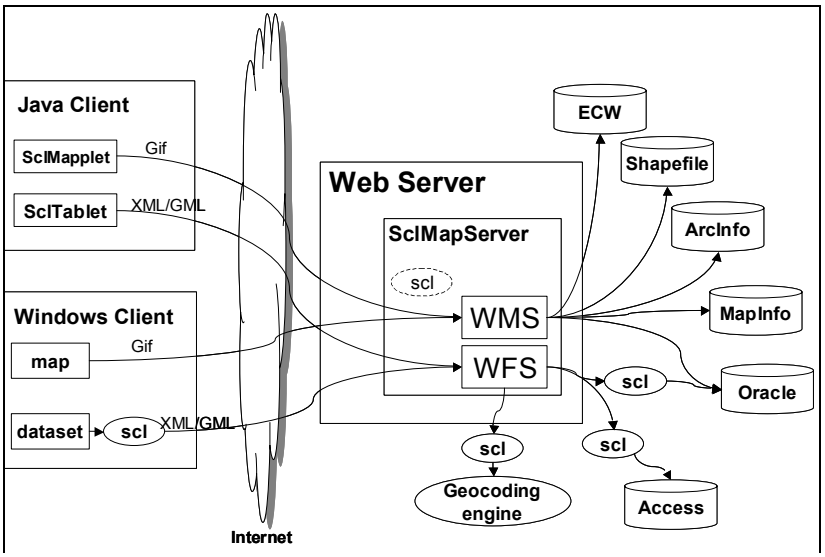

Figure 6 illustrates the architecture of thick and thin client for MapSwing.

Compliance with OGC

The compliance to OGC specifications of the various components is listed in Table 6.

Table 6 OGC certifications for MapSwing components (source: www.opengis.org).

Component	OGC specification compliance	Type
SclMapProxy	WMS 1.1.0	Proxy (Client/Server)
SclMapServer	WMS 1.1.0	Web Mapping Server
SclMapplet (Java Applet – Mapplet)	WMS 1.1.0	Client
SclMapServer	WMS 1.1.0	Web feature server
SclMapServer Apache module	WMS 1.1.0	Web mapping server
SclMapServer Apache module	WMS 1.1.0	Web feature server

Data formats supported

Data formats supported are:

- MapInfo binary files
- Esri Shape files
- Dbase files
- Oracle 8.1.7 and Oracle 9i with Spatial
- ECW files from ErMapper for Raster data
- Esri ArcInfo coverage
- plus several other minor formats used in the GIS industry.