WebGIS - Mapserver

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Geospatial Data Infrastructure (GDI)

GDI is the framework of political, technical and economical infrastructures that are necessary to acquire, process, distribute, use, maintain, update and preserve spatial data.

It is built by Geographical Information System (GIS), and distribution networks of data and services.
Distributed Geographic Information (DGI)

It is a technology distributed on a computer network to enable the distribution, interconnection and integration of geographic information.

The most common mean to distribute data consists in a computer network (Internet or Intranet).

GIS capable to operate in distributed environment and interconnected (networked computer environment) are necessary.
WebGIS

It is a distributed GIS via a network to share, interconnect and integrate geographic information in a graphical representation through Word Wide Web in Internet.

It is based on the client/server structure tipical of the Web

request of map or processing

Web browser

client

data and/or images

server

GIS functions
The systems are characterized by different complexity, "weight" of data and content depending on the users (Intranet/Internet).

WebGIS systems are not (they should not be?) extensions of existing GIS because they cater to a different class of users.

In a WebGIS the aspects of data transmission (Web) and spatial processing are not separable (for ex. type of transmitted data and transmission speed).
The maps created by a WebGIS can be classified in:

**Static maps:**
- represented objects and map components are fixed;
- correspond to traditional maps (printed on paper);
- are easily incorporated in hyper-texts in the Web.

**Dynamic maps:**
- represent a dynamic reality through animations;
- are automatically updated in real time together with data update (for example meteorological maps);
- are seldom used in WebGIS.
Maps in a WebGIS

Display only maps:
• no interactions are possible;
• the images are included in hyper-texts in different formats Gif/Jpeg/Pdf;
• are less usable than the printed maps.

Interactive maps:
• allow display changes (zoom, colors...);
• allow changing of a map content (layer...);
• allow the connections of graphic elements to other information (tables, images...).
The map produced by a WebGIS may allow a user to:

- control display settings (zoom and panning);
- find the position (coordinates) and the meaning of the displayed objects (legend);
- query the map and the database (query);
- combine data at different scale and detail;
- create tailored thematic maps;
- link the elements of a map to other data (maps, tables...) and to create links to predefined views of a map.
Different approaches are possible to distribute processing load

Server side

All the information are processed by the server:
• quick answer;
• each interaction of the user forces the server to send a new map.

Client side

Part of the processing is carried out by the client, by means of functions or whole applications created by plug-in or applet Java:
• the client must download the plug-in (it is heavy but this must be done only once) or the applet;
• it is possible to send more complex and "intelligent" data carry out some operations directly in the client;
• it is possible to integrate server data with local data.
ESRI ArcIMS (ArcView Internet Map Server)

Platforms:
UNIX (Linux/HP-UX/ AIX/Solaris) o Windows 2003/2008 server, XP Prof., Vista/7 Ultimate;
• Web Server (Apache/IIS/Sun Glassgifsh/Websfere/Oracle Weblogic/JBoss) con Servlet Engine (non incluso);
  Application Server (Middle-ware);
• Spatial Server + Database (ArcSDE).

Tecnologies:
• Remote management (Servlet Engine);
• Extensible Markup Language (XML) --> ArcXML;
• JavaScripts, Java applets e Servlets, .NET, Cold Fusion, ASP;
• display: vector (feature server) and raster (image server);
• browser (client): version HTML or with Java applets.
Intergraph Geomedia WebMap Professional
http://www.intergraph.com/sgi/products/

Platforms:
Windows NT, 2000, 2003 server, XP Prof.;
Web Server (Microsoft IIS) con Active Server Pages (ASP);
COM + ODBC;
GeoMedia Data Servers --> multiple data.

Technologies:
technology based on Microsoft COM, XML, .NET;
ActiveX scripting, ActiveX controlse VB Script;
Client: Arctive CGM plug-in (Computer Graphics Metafile);
Display: vector -- ActiveCGM + MDF (Map definition Files)
raster -- GeoTIFF, JPEG, GIF, INTERGRAPH
AutoDesk MapGuide

http://usa.autodesk.com/adsk/servlet/pc/index?siteID=123112&id=2995478

Platforms:
- Windows NT, 2000, 2003 server, XP Prof./Java machine;
- Web Server (IIS) o SunSM ONE Web Server;
- Database connection: OLE-DB or ODBC;
- Database supportati: Oracles 10g and Microsoft SQL server.

Tecnologies:
- Spatial Data Files (SDFs)
- Development environmentbased on Microsoft COM;
- Client: Arctive CGM plug-in (Computer Graphics Metafile);
- Display: vector and raster;
- Viewer: versioni Plug-ins and HTML.

An Open Source version (LGPL) “MapGuide Open Source” is available:
https://mapguide.osgeo.org/
GE SmallWorld Internet Application Server

Platforms:
• Intel: Windows NT (2000) or RedHat Linux 6.1;
• Web Server: IIS (Windows), Netscape Enterprise, or Apache (Linux);
• Smallworld 3 core products and extended services;
• Middle-ware: CGI or Servlet Engine (not included).

Tecnologies:
• respects OpenGIS WMT specifications (Web Mapping Test-bed);
• Smallworld Magik to develop applications;
• Smallworld: Object-Oriented GIS;
• browser (client): version HTML or Java (Java applets or Java applications).
MapInfo MapXtreme

Platforms:
Java (Unix/Windows)
Web Server (Microsoft IIS) with Active Server Pages (ASP).

ER Mapper Image Web Server
http://www.earthetc.com

The Image Web Server allows Microsoft Web Server to send large images to web browser or applications via the Internet. The browser (client) must install ECW plug-in, freely distributed. It can be integrated with ESRI ArcIMS.
MapServer is “an Open Source platform for publishing spatial data and interactive mapping applications to the web”.

Originally developed by University of Minnesota (UMN) and by NASA, it is currently a project of the Open Source Geospatial Foundation (OSGeo).

It a FOSS system.

Official site of MapServer is http://mapserver.org/ (http://www.osgeo.org/mapserver)
MapServer can be integrated with other FOSS (libraries):

- GD - graphic output (PNG);
- FreeType - TrueType support;
- PROJ4 - coordinate conversion in different projection systems;
- LibCURL - WMS support (OpenGIS Web Map Server standard);
- LibTiff - Tiff support;
- LibGeoTiff – GeoTiff support;
- LibJPEG - Jpeg support;
- Shapelib - read/write of vector data in Shape format;
- OGR Simple Feature Library – vector data management in different formats;
- GDAL (Geospatial Data Abstraction Library) - raster data management in different formats;
- SDE Client Libraries - ArcSDE ESRI interchange;
- PostgreSQL Client Library - interface to PostGIS;
- Oracle Spatial Client Libraries - interface to Oracle database;
- MING - Macromedia Flash support;
- PDFLib/PDFLib Lite – PDF output (libraries not entirely Open Source), or FPDF with PHP.
MapServer can be installed/compiled in:

Unix and Unix-like:
  - Hp-UX;
  - Linux;
  - ...

Mac OS X

MS Windows:
  - Windows 95
  - Windows 98
  - Windows NT
  - Windows 2000
  - Windows Xp
  - Windows server 2003/2008
  - Vista
  - Seven

Web server: Apache 1 e 2, IIS.
The source can be downloaded from (21/2/2011):

http://download.osgeo.org/mapserver/mapserver-5.6.6.tar.gz

The binary packages for the different Linux distributions are available in the relative repository.

FSG (http://maptools.org/fgs/) is an installer for Mapserver and its dependencies for different Linux distributions (Fedora Core 2, Debian Sarge, Debian Etch, Gentoo, Centos 4, Centos 5 e Ubuntu).

The packages for Mac OS X are available in KyngChaos (http://www.kyngchaos.com/wiki/software:mapserver).
MapServer Binary distributions for Windows:

**OSGeo4W** ([http://trac.osgeo.org/osgeo4w/](http://trac.osgeo.org/osgeo4w/))
OSGeo4W is a complete distribution of geospatial software Open Source for Win32 environment (Windows XP, Vista, etc). OSGeo4W includes GDAL/OGR, GRASS, MapServer, OpenEV, uDig, ...

**MS4W** (MapServer for Windows - [http://maptools.org/ms4w/](http://maptools.org/ms4w/))
MS4W is a package with HTTPD/PHP/MapScript/MapServer that provides a complete web mapping environment.
MS4W includes MapScript for PHP, C# and Python, Java MapScript, additional DLL for SDE and Oracle support.

**FWTools** (Linux/Windows - [http://fwtools.maptools.org/](http://fwtools.maptools.org/))
A collection of GIS Open Source tools that includes, not only the base web mapping instruments but also utilities to create, manage and distribute spatial data.
MapServer supports the following scripting languages:

- Perl;
- Python;
- Tk/Tcl;
- Guile;
- Java(script);
- PHP/MapScript.
- Ruby;
- C#.
Supported formats

Raster data:
- TIFF/GeoTIFF;
- GIF;
- PNG;
- ERDAS;
- JPEG.

+ all GDAL formats.

Vector data:
- ESRI shapefile (default);
- PostgreSQL/PostGIS;
- ESRI ArcSDE;
- Oracle Spatial;
- MySQL/MySQL Spatial.

+ all OGR formats.
Standard features:

- Open Geospatial Consortium (OGC) web specifications: WMS (client/server), non-transactional WFS (client/server), WMC, WCS, Filter Encoding, SLD, GML, SOS;
- quadtree spatial indexing, GisT;
- output can be tailored via template;
- selection of feature by object/value, point, area, ...;
- TrueType and tiled data support (raster and vector);
- automatic generation of legends and scale bars (static);
- display and processing scale dependent;
- generation of thematic maps using of logic or "regular" expressions;
- automatic labeling with overlaying management;
- on-the-fly configuration through URL;
- on-the-fly projection change.
Supported OGC standards

Supported OGC standard:

- Web Map Service (OGC:WMS) 1.0.0, 1.0.7, 1.1.0 and 1.1.1
- Web Feature Service (OGC:WFS) 1.0.0, 1.1.0
- Web Coverage Service (OGC:WCS) 1.0.0, 1.1.0
- Geography Markup Language (OGC:GML) 2.1.2, 3.1.0 Level 0 Profile
- Web Map Context Documents (OGC:WMC) 1.0.0, 1.1.0
- Styled Layer Descriptor (OGC:SLD) 1.0.0
- Filter Encoding Specification (OGC:FES) 1.0.0
- Sensor Observation Service (OGC:SOS) 1.0.0
- Observations and Measurements (OGC:OM) 1.0.0
- SWE Common (OGC:SWE) 1.0.1
- OWS Common (OGC:OWS) 1.0.0, 1.1.0
MapServer (unless MapServer API are directly used) runs as a CGI application through a http server.

The CGI application uses:
• a http server (ex. Apache);
• MapServer;
• an initialization file of the application (optional);
• a mapfile that controls how data is used by MapServer;
• a template file that controls the page appearance;
• a GIS dataset.
 Initialization file

gives the base MapServer parameters as hidden parameters in a html form.

Can be embedded in another html file, but it is preferable to keep it separate.

<head><title>Titolo</title></head>
<body>
<center><h2>File di inizializzazione</h2></center>
<form method=GET action="/cgi-bin/mapserv">
<input type="hidden" name="program" value="/cgi-bin/mapserv">
<input type="hidden" name="map_web_imagepath" value="/usr/tmp/">
<input type="hidden" name="map_web_imageurl" value="/tmp/">
<input type="hidden" name="map" value="/home/paolo/dati/prova.map">
<input type="hidden" name="layer" value="strade">
<input type="hidden" name="zoomsize" value=2>
<center><input type="submit" value="Visualizza la mappa"></center>
</form>
</body></html>
defines how data is used and sets the display and query parameters for the map.

NAME "prova"
UNITS meters
EXTENT 1663688.20905147 5101942.17692661 1664946.11718815 5105702.06988269
SIZE 300 700
SHAPEPATH "/home/paolo/dati/"

WEB
  TEMPLATE "prova.html"
  IMAGEPATH "/usr/tmp/"
  IMAGEURL "/tmp/"
END

SCALEBAR
  STATUS ON
  INTERVALS 4
  SIZE 200 2
  BACKGROUNDCOLOR 220 220 220
  COLOR 0 0 0
  UNITS meters
  STYLE 0
  LABEL
    COLOR 0 0 0
    SIZE small
  END
END

LAYER
  NAME strade
  TYPE LINE
  STATUS ON
  DATA strade1
  CLASSITEM vect_id
  LABELITEM nome

  CLASS
    EXPRESSION /83/
    COLOR 255 0 0
    LABEL
      TYPE BITMAP
      SIZE small
      COLOR 0 0 0
    END
    END

  QUERY
    TEMPLATE prova_query.html
    END
END
END
END
Objects in a MAP file:

- MAP
  - Layer
    - Query
      - Join
    - Class
      - Label
  - Legend
    - Label
  - Querymap
  - Reference
  - Scalebar
    - Label
  - Web
Objects in a MAP file:

- FEATURE
- FONTSET
- INCLUDE
- GRID
- JOIN
- LABEL
- LAYER
- LEGEND
- MAP

- OUTPUTFORMAT
- PROJECTION
- QUERYMAP
- REFERENCE
- SCALEBAR
- STYLE
- SYMBOL
- WEB
controls the appearance of the maps and the legends created by MapServer on the html page. It defines the type of interaction with the user.

Key words are dynamically substituted by MapServer to display the proper maps.
Workflow

User (Web browser)

User Parameters

Web server

Template file
MAP file
Initialization file

MapServer (CGI)
It is possible to create dynamic pages using a script language, for example *mapscript*.
Applications that allow the creation of dynamic WebGIS with Mapserver, making available high level features:

• MapLab;
• Ka-map;
• Chamaleon;
• MuseMap;
• CartoWeb.

They can be found at http://www.maptools.org/.
MapLab is a tool to automatically generate MAP files and template via a graphic interface.

It is based on three tools:
• MapEdit - creates, modifies and manages MAP files;
• MapBrowser – displays local and remote applications;
• GMapFactory – creates web mapping applications (integration of scripts and so on).

MapLab is no more developed, Quantum GIS (QGIS) or MapStorer can be used instead.
Compilation

Starting from source code:

- download the mapserver-5.6.6.tar.gz package
- decompress the package with `tar xzvf mapserver-5.6.6.tar.gz`
- configure with `./configure`;
- check the availability of that all required libraries;
- the following libraries must be explicitly selected: PROJ.4, SDE, OGR, GDAL, LibCURL e MPATROL;
- compile with `make`. 
MapServer consists in the single executable `mapserver`.

It must be copied in the directory in which the http server searches CGI programs, for example for Apache `/usr/local/apache/cgi-bin`.

Depending on OS configuration settings, maybe necessary to be system administrator (root) to perform this operation.

It is necessary to be sure that mapserver file is executable from http server.
MapServer used the Open Source library GD (now AG, GD is deprecated) for rendering.

Since version 1.6 to 2.0.28 GD does not support GIF format because it uses algorithm LZW (UNISYS copyright). Copyright has expired on 7/7/2003 for USA and on 7/7/2004 for the rest of the world, version 2.0.28 (21/7/2004) supports GIF read/write.

Since version 3.5 to 4.4 MapServer does not support GIF, current versions do.
MapServer supports OpenGIS Consortium standard: WMS (client/server), non-transactional WFS (client/server), WMC, WCS, Filter Encoding, SLD, GML, SOS, OM.

Support is automatically active if PROJ.4 support is activated.

Mapserver can work as a feature server, providing single themes to remote applications, and also as a catalog server.

Supports also cascading: it can integrate maps from other MapServer and FeatureServer servers with local data in a map.
MapServer is able to use data directly provided by a database engine with spatial extension.

Compatible database engines:
ESRI SDE, both geometry and attributes (compile with options --with-sde and --with-sde-version);
PostGIS, "spatially enabled" version of PostgreSQL, (compile with --with-postgis);
Oracle Spatial Warehousing, (compile with --with-oraclespatial);
MySQL Spatial, (compile with --with-oraclespatial).
The Mapserver gallery of application is at the address http://mapserver.gis.umn.edu/gallery.html

About 100 different and heterogeneous applications are listed:
- cadaster;
- land use;
- geographic data distribution;
- petrol prospection;
- Land planning;
- tourist information;
- etc.
World map with place name lookup
http://imaptools.com/vmap0a/
Tiger data

iMAP TOOLS
Tiger (US.Census Bureau) database lookup
http://imaptools.com/tiger/
Greenwood Mapping, Inc.
County government site with an emphasis on land records
http://www2.tetonwyo.org/mapserver/
Canadian Atlas

Map Topics

- Environment
- People & Society
- Economy
- History
- Climate Change
- Freshwater
- Health

Reference Maps
Map Archives

http://atlas.gc.ca/site/index.html
http://mapserver.gis.umn.edu/gallery/owsBureauofMeteorology
A site where Swiss cartography is distributed.

http://www.ortsplan.ch/
Homburg (Germany)

http://www.bad-homburg.de/stadtplan2004/start.php?&site=badhomburg
Joint Research Centre of the European Commission

Image 2000 Acquisition Archive

Map Layers

- Image 2000
- Project Sites
- Countries

Legend
- Europe
- Panchromatic
- Multispectral
- HRIS Project Sample Sites

Reference Map

http://data-dist.jrc.it/mapserver
Information about Ischia island and tourist services

http://www.ischiamappe.it/
Autorità di bacino del fiume Po

Autorità di bacino del fiume Po

Bacino di rilievo nazionale

Esci dall’area WebGIS e torna al portale informativo

http://www.adbpo.it/maplab_projects/webgis/adbpo_gis/inizio.phtml?inizio=APi
CRS4 – Sardegna, monitoring of ground water pollution

http://datacrossing.crs4.it/en_Documentation_mscross.html
Parco del basilico di Genova [http://parco-basilico.provincia.genova.it/ita/credits.html](http://parco-basilico.provincia.genova.it/ita/credits.html)

CartaSicilia (under construction) [http://www.cartasicilia.it](http://www.cartasicilia.it)

Su Per Sentieri ([supersentieri.itc.it](http://supersentieri.itc.it))
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