GeoSolutions

2014

Profile, Past Performance and Professional's Qualifications

Ing. Simone Giannecchini
Dr. Eleonora Fontana
GeoSolutions S.A.S.
## Contents

**GeoSolutions Profile** .................................................................................. 7

**GeoSolutions Commercial focus** ................................................................ 7

**GeoSolutions administrative information** .................................................. 9

  - Administrative details.................................................................................. 9
  - Point of contacts....................................................................................... 9

**GeoSolutions Relevant Work Experience** .................................................. 10

**GeoSolutions permission to contact clients** ................................................ 10

  - NATO NURC MiIOC (Military Oceanography) department Support .......... 11
  - GEOS2 Architecture.................................................................................. 11
  - Cruise Support......................................................................................... 12
  - Data Fusion Center server farm................................................................. 12
  - Gridded Data Server.................................................................................. 14
  - OGC Services - GeoServer.......................................................................... 17
  - OMAR ebRIM customization...................................................................... 17
  - JPIP Server............................................................................................... 18
  - FTP Server and watch folders.................................................................... 18
  - Gridded Data Server User Interface............................................................ 20
  - Gridded Data Server Job Service................................................................. 22
  - FAO – Global Early Warning System 3.0 (Fenix)........................................ 24
  - NATO NURC SAS Mission Manager.......................................................... 27
  - SAS Manager Architecture....................................................................... 28
  - LogiteCNA – Intelligent Transportation System.......................................... 33
  - Authentication, Authorization and Accounting........................................... 36
  - RUOTA, router and connector.................................................................... 36
  - Statistics.................................................................................................... 36
  - GeoCoding and Reverse GeoCoding.......................................................... 37
  - Routing..................................................................................................... 37
  - Support for FAO Fishery Department activities......................................... 39

---

**GeoSolutions S.A.S.**

Via Carignani 51, 55041 Camaiore, Italy

VAT IT 02036020465

Phone: +390584962313

Fax: +3905841660272

http://www.geo-solutions.it

info@geo-solutions.it

---

**ALL RIGHTS RESERVED** – This document is the exclusive property of GeoSolutions S.A.S. which reserves all rights there to. Therefore this document may not be copied, reproduced, communicated or disclosed to others than the intended recipient or used in any way, not even for experimental purposes, without written permission of GeoSolutions S.A.S. and upon request it shall be promptly returned to GeoSolutions S.A.S., Camaiore, Italy.
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>GeoServer as geospatial DataBase for FIGIS spatial datasets</td>
<td>41</td>
</tr>
<tr>
<td>GeoWebcache for map layers optimization</td>
<td>42</td>
</tr>
<tr>
<td>Dynamic maps on FIGIS resources fact sheets</td>
<td>43</td>
</tr>
<tr>
<td>Regional Fishery Bodies Viewer</td>
<td>44</td>
</tr>
<tr>
<td>Tuna Atlas and Billfish catches statistical application</td>
<td>48</td>
</tr>
<tr>
<td>Support for FAO CIOK Department</td>
<td>49</td>
</tr>
<tr>
<td>Platforms involved</td>
<td>49</td>
</tr>
<tr>
<td>ZonalStats process</td>
<td>50</td>
</tr>
<tr>
<td>BufferZonalStats process</td>
<td>51</td>
</tr>
<tr>
<td>Data.fao.org Infrastructure</td>
<td>51</td>
</tr>
<tr>
<td>NURC Oceanographic Database</td>
<td>53</td>
</tr>
<tr>
<td>E-GEOS Sistema Informativo Agricolo Nazionale (SIAN)</td>
<td>57</td>
</tr>
<tr>
<td>ACQUE SPA GeoPortal</td>
<td>63</td>
</tr>
<tr>
<td>City of Florence GeoPortal</td>
<td>65</td>
</tr>
<tr>
<td>FAO – Fouta Dжаллон Highlands (FDH) Atlas</td>
<td>67</td>
</tr>
<tr>
<td>CSI Piemonte – GeoPortal</td>
<td>69</td>
</tr>
<tr>
<td>CSI Piemonte – Destination Project</td>
<td>70</td>
</tr>
<tr>
<td>NATO CMRE Super Ensemble Modeling</td>
<td>74</td>
</tr>
<tr>
<td>NATO CMRE GEOS III Infrastructure</td>
<td>77</td>
</tr>
<tr>
<td>NATO CMRE Gliders Portal</td>
<td>80</td>
</tr>
<tr>
<td>LaMMa GeoPortal</td>
<td>82</td>
</tr>
<tr>
<td>NATO CMRE IDA</td>
<td>87</td>
</tr>
<tr>
<td>Consult HTS</td>
<td>90</td>
</tr>
<tr>
<td>University of Naples - HPC applications for Land Use Change Computation</td>
<td>93</td>
</tr>
<tr>
<td>DLR &amp; EUMETSAT GeoServer Improvements</td>
<td>95</td>
</tr>
<tr>
<td>LiberoLogico – CUSTOM Project, Cloud Computing &amp; Application Store for Tourism &amp; Culture</td>
<td>101</td>
</tr>
<tr>
<td>NATO CMRE OpenData Portal</td>
<td>105</td>
</tr>
<tr>
<td>OpenDataNetwork Project</td>
<td>109</td>
</tr>
</tbody>
</table>
Illustration 1 GDFC Network and Server Farm ......................................................... 13
Illustration 2 Gridded Data Server component diagram ........................................ 16
Illustration 3 Exposing GDS configuration in JBoss JMX-Console ......................... 17
Illustration 4 FTP Configuration interface ................................................................ 19
Illustration 5 Administration interface for WatchFolders ....................................... 20
Illustration 6 GDS User interface -1- ........................................................................ 21
Illustration 7 GDS User intertace -2- ........................................................................ 22
Illustration 8 Gridded Data Server Job Service ....................................................... 23
Illustration 9 SLD editor widget, details of the polygon symbolizer widget ............. 25
Illustration 10 SLD editor widget, details of the color picker widget ..................... 25
Illustration 11 RasterSymbolizer at work ................................................................. 26
Illustration 12 Mission Data Package ....................................................................... 27
Illustration 13 SAS Mission Manager Architecture ................................................ 28
Illustration 14 ESB as the SAS-Manager backbone .................................................. 29
Illustration 15: SAS data mosaic .............................................................................. 30
Illustration 16 SAS Manager GUI ............................................................................ 31
Illustration 17: Getting raw data ............................................................................. 32
Illustration 18 LogiteCNA Architecture ................................................................... 34
Illustration 19 Real time monitoring of GPS events ................................................ 35
Illustration 20 LogiteCNA Density Maps ................................................................. 37
Illustration 21 GeoServer as geospatial DataBase for FIGIS spatial datasets ........ 42
Illustration 22 GeoWebCache deployment -1- ........................................................... 43
Illustration 23 GeoWebCache deployment -2- ........................................................... 43
Illustration 24 Resource fact sheet for the species Gadus morhua ....................... 45
Illustration 25 RFB early prototype ......................................................................... 46
Illustration 26 RFB final prototype -1- ................................................................. 47
Illustration 27 RFB final prototype -2- ................................................................. 47
Illustration 28 Tuna Atlas Front End ....................................................................... 48
Illustration 29 Tuna atlas map ................................................................................ 48
Illustration 30 Infrastructure of CIOK WPS ............................................................ 50
Illustration 31 FAO CIOK Department future architecture ........................................ 52
Illustration 32 Glider path ....................................................................................... 53
Illustration 33 CTD probe ...................................................................................... 54
Illustration 34 Web GIS front-end application ........................................................ 55
Illustration 35 Glider view in Google Earth .............................................................. 56
Illustration 36 Glider view in Google Earth (view under the surface of the sea) ...... 56
Illustration 37 SIN-SDI hardware/software architecture ....................................... 60
Illustration 38 SIAN SDI Infrastructure ................................................................. 61

GeoSolutions S.A.S
Via Carignani 51, 55041 Camaiore, Italy
VAT # IT 02036020465
Phone: +390584962313
Fax: +3905841660272
http://www.geo-solutions.it
info@geo-solutions.it

ALL RIGHTS RESERVED – This document is the exclusive property of GeoSolutions S.A.S. which reserves all rights thereto. Therefore this document may not be copied, reproduced, communicated or disclosed to others than the intended recipient or used in any way, not even for experimental purposes, without written permission of GeoSolutions S.A.S. and upon request it shall be promptly returned to GeoSolutions S.A.S., Camaiore, Italy.
Illustration 39 GeoRepository Infrastructure ................................................................. 62
Illustration 40 Acque GeoPortal .................................................................................. 64
Illustration 41 City of Florence OpenGeoData Portal ............................................... 66
Illustration 42 FDH Atlas at work ............................................................................... 68
Illustration 43 CSI Piemonte GeoPortal at work ....................................................... 69
Illustration 44 MapStore Customization for DESTINATION project ....................... 74
Illustration 45 Super Ensemble Modeling infrastructure .......................................... 75
Illustration 46 Super Ensemble Modeling connections between components ............. 76
Illustration 47 GEOS III SSO at work ........................................................................ 79
Illustration 48 Gliders Portal at work ......................................................................... 81
Illustration 49 Multiple sources of data overlayed with support for TIME in the front-end 85
Illustration 50 High Level Overview of the LaMMA Infrastructure .............................. 86
Illustration 51 CMRE IDA front-end ........................................................................ 88
Illustration 52 IDA Overall Infrastructure .................................................................. 89
Illustration 53 FreightTrain at work .......................................................................... 91
Illustration 54 FreightTrain webmapping interface based on OpenLayers at work .... 92
Illustration 55 Indexing a single multidimensional NetCDF file ............................... 98
Illustration 56 Indexing a single NetCDF file ............................................................ 99
Illustration 57 A single multidimensional mosaic for multiple multidimensional NetCDF files 99
Illustration 58 Overall proposed infrastructure ........................................................ 100
Illustration 59 The CUSTOM Infrastructure in one slide .......................................... 103
Illustration 60 The Geographic Building Block ......................................................... 104
Illustration 61 CMRE OpenData Portal CKAN User Interface ................................. 107
Illustration 62 CMRE OpenData Portal CKAN Resource Details ............................. 108
GeoSolutions Profile

GeoSolutions is a company highly specialized in the processing and dissemination of raster and vector geospatial data with Open Source software according to the specifications created by Open GeoSpatial consortium (OGC) and the ISO Technical Committee 211 which provide the base building blocks for the INSPIRE regulations.

The GeoSolutions team is composed by renowned international professionals with leading roles in some of the main Open Source products for the geospatial field like GeoServer, GeoNetwork and MapStore for which GeoSolutions provides professional support services.

GeoSolutions counts among its customers major national and international government agencies as well as private companies worldwide. United Nations Food and Agriculture Organization (FAO), United Nations World Food Program (WFP), NATO NURC as well as the Municipalities of Prato and Firenze and the province of Florence have chosen GeoSolutions to support their infrastructures.

Thanks to the wide experience gained in supporting mid-size and large enterprise Environments for mission critical projects, GeoSolutions is able to provide highly customized solutions based upon Open Source components with proven reliability in order to respond promptly and efficiently to the customers’ needs.

The primary objective of GeoSolutions is the integration and the complete interoperability with COTS software and/or pre-existing infrastructures.

GeoSolutions offers professional support services to help organizations building enterprise-class Spatial Data Infrastructures (SDI), integrating and tuning best-of-breed Open Source geospatial frameworks in the OpenSDI Suite. OpenSDI Suite consists of Open Source products with proven robustness and reliability among which we mention GeoWebCache the flexible, efficient and economic solutions for the acceleration of the dissemination of the maps into client oriented tile such as Google Map or Google Earth; GeoServer, the Open Source server for the management and interoperable dissemination of geospatial data according to the OGC, ISO and INSPIRE standard; GeoNetwork, the Open Source catalogue server for the management and dissemination of GeoSpatial metadata according to the OGC and ISO as well as INSPIRE standards; MapStore the innovative webmapping solution to create, save, browse and share in a simple and intuitive way mashups created using content from sources server like Google Maps, OpenStreetMap, MapQuest or specific servers provided by your organization or anyone else.

GeoSolutions Commercial focus

GeoSolutions is highly specialized in the following fields:

1. Management, processing and dissemination of geospatial data following OGC and ISO TC 211 specification using Open Source software written in Java.
2. Image Processing in Java
3. Advanced 2D visualization of geospatial data in Java

GeoSolutions’ associates are developers of a variety of open source software, namely:

- **GeoServer**: GeoSolutions staff members are part of the project steering committee and core developers.
- **GeoNetwork**: GeoSolutions staff members are part of the project steering committee and core developers.
- **MapStore**: GeoSolutions staff members are part of the project steering committee and core developers.
- **GeoTools**: GeoSolutions staff members are part of the project steering committee and core developers.
- **GeoBatch**: GeoSolutions staff members are founder and core developers.
- **ImageIO-Ext**: GeoSolutions staff members are founder, part of the project steering committee and core developers.
- **JAI Tools**: GeoSolutions staff members are founder, part of the project steering committee, core developers.

GeoSolutions provides the following professional services centered around the geospatial Open Source Software mentioned above:

- Personalized and on-the-field Training
- Custom Application Development
- Professional Support Services

---

1. [http://www.geoserver.org](http://www.geoserver.org)
3. [http://mapstore.geo-solutions.it](http://mapstore.geo-solutions.it)
4. [http://www.geotools.org](http://www.geotools.org)
5. [http://docs.codehaus.org/geobatch](http://docs.codehaus.org/geobatch)
6. [http://imageio-ext.dev.java.net](http://imageio-ext.dev.java.net)
Profile, Past Performance and Professional's Qualifications

GeoSolutions administrative information

Administrative details
GeoSolutions S.A.S. di Simone Giannecchini & C.
Via Carignoni 51
55041 Camaiore
Lucca, Italy
Phone: +390584 962313
Fax: +390584 16602072
Email: info@geo-solutions.it
Site: http://www.geo-solutions.it
VAT: 02036020465

Point of contacts
Ing. Simone Giannecchini
Managing Director
Phone: +390584 962313
Fax: +390584 16602072
Mobile: +3933381128928
Email: simone.giannecchini@geo-solutions.it

Dr. Eleonora Fontana
Director of Sales & Business Dev.
Phone: +390584 962313
Fax: +390584 16602072
Mobile: +393316253196
Email: eleonora.fontana@geo-solutions.it
GeoSolutions Relevant Work Experience

In the following sections we are going to provide detailed information about relevant work experience for past and ongoing projects performed by GeoSolutions with the objective to provide concrete proof of our expertise. For each experience reported we summarize at the beginning the core technologies used, the GeoSolutions personnel that followed the project as well as the status of the project itself.

GeoSolutions permission to contact clients

For each project we are going to present we also provide at least one Point Of Contact (POC) for the client which could be contacted by the reader of this document in order to obtain additional information about the project or confirmation about the information we have provided.
NATO NURC MiLOC (Military Oceanography) department Support

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATO CMRE</td>
<td></td>
</tr>
<tr>
<td><strong>Information</strong></td>
<td><strong>POC</strong></td>
</tr>
<tr>
<td></td>
<td>Ing. Giampaolo Cimino, <a href="mailto:grasso@cmre.nato.int">grasso@cmre.nato.int</a></td>
</tr>
<tr>
<td></td>
<td>Ing. Raffaele Grasso, <a href="mailto:cimino@cmre.nato.int">cimino@cmre.nato.int</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java, C++, JavaScript, HTML, XML, XSD, JMX, SOAP</td>
<td>Ing. Simone Giannecchini</td>
</tr>
<tr>
<td>GeoServer, GeoTools, PostGIS</td>
<td>Ing. Alessio Fabiani</td>
</tr>
<tr>
<td>OGC Protocols and Specifications</td>
<td>Ing. Daniele Romagnoli</td>
</tr>
<tr>
<td>Apache Tomcat, Apache HTTP, LDAP, Microsoft IIS, Microsoft Active Directory</td>
<td></td>
</tr>
<tr>
<td>Windows, Linux</td>
<td></td>
</tr>
</tbody>
</table>

This section briefly summarizes some relevant examples and activities that GeoSolutions team has performed for MiLOC dept and Data Fusion Center during the past consultancy period.

**GEOS2 Architecture**

GeoSolutions has provided support to the Geospatial Data Fusion Centre at all levels, hardware, software and network administration and configuration. In particular we have configured and managed the GEOS2 geospatial server, and all internal the security infrastructure, which after agreements taken with the CIS department, has been delegated to the MiLOC. We have set up a Domain Controller (see Illustration 1) upon a MS Windows 2003 Server operative system, which handles all the GDFC Security Groups and Users by using the Active Directory technology. Active Directory directly handles the FTP service, by controlling user and group rights on a per directory structure. The HTTP service is provided by Apache 2 HTTP Server instead. However all the Virtual Hosts or Web Directories and Locations are protected by accessing via LDAP protocol to the GEOS2 Active Directory security sub-system, so that it uses the same users and security groups of the Domain Controller. The Java2 EE web services are provided by two twin Apache Tomcat installations, actually running on GEOS2 and accessed and controlled through an AJP Proxy connector by the Apache HTTP Server.
Cruise Support
GeoSolutions has provided support to various NURC scientific cruises by setting-up and managing geospatial support services both at the Fusion Center and on board. During DART05 cruise, GeoSolutions personnel was boarded to provide direct support for a GEOS2 Server mirror deployed on the research vessel NRV-Alliance. The task of GeoSolutions were to setup, configure and control the automatic mirroring system on board. The necessity of having a GEOS2 mirror aboard for MilOC was in that case because of the wide amount of data transferred between scientist PCs on the ship and model and remote-sensing products sent by the different research institutes on GEOS2 against a small-bandwidth and best-effort network connection provided by a satellite link.

Data Fusion Center server farm
One of the projects GeoSolutions is nowadays directly involved to, is the re-organization of the whole Data Fusion network and server farm. After having observed that GEOS2 alone was not sufficient to support the ever growing amount of geospatial applications developed at the GDFC, GeoSolutions and MilOC have proposed together a brand new server farm configuration to NURC that was accepted and actually under development.

As depicted in Illustration 1 GDFC Network and Server Farm, GEOS2 server load is now distributed on two twin geospatial servers which handles Apache Tomcat instances, thus providing all the geospatial application support.

Front-End server provides basically just HTTP and Proxy services with a substantially improved grade of security, while the Domain Controller and all the security sub-system is ever provided by GEOS2 which now resides entirely on a secured independent network.
Illustration 1 GDFC Network and Server Farm
The Gridded Data Server (GDS) is a geospatial data server whose role is to act as a repository for gridded data, in order to allow users to upload, ingest index, process and retrieve via ISO and OGC protocols (WCS, WMS, JPIP) raster data. The GDS is based on several Java components and framework, like JBoss-AS.4.2.3-GA, which is the J2EE Server and EJB Container at the base of the whole architecture, EbXMLRR-OMAR, which is an Open-Source framework implementing the ebXMLRRS Catalog, GeoServer which is an OGC geospatial server, and, eventually IAS 1.5, which is a JPIP server from ITT-VIS (see Illustration 2).

The functionalities provided by the server are as follows:

1. Administration user interface integrated with JBoss JMX administration console
2. WMS, WCS, WFS and WPS via the GeoServer
3. FTP service to upload data with separate home directories on a per user base

4. EBRIM interface to:
   a. Browse the ingested datasets
   b. Retrieve metadata about the deployed services

5. SOA Job service to:
   a. Perform optimized upload, ingestion and conversion of datasets
   b. Perform FeatureExtraction via IDL\(^8\) code on raster data
   c. Download a list of input datasets to an external FTP
   d. Replicate a certain number of input datasets on a target GDS

6. User interface to interact with the services and datasets

The GDS is completely configurable via a specific administrative interface that integrates with the JBoss JMX administration console (more details will be provided afterwards). Moreover a loosely coupled client application for adding and browsing the content of the GDS itself (via interacting with the embedded EbRIM registry) is provided. In the following subsections we will briefly describe the various components that compose the Gridded Data Server, as shown in Illustration 2.

\(^8\) [http://www.ittvis.com/ProductServices/IDL.aspx](http://www.ittvis.com/ProductServices/IDL.aspx)
Illustration 2 Gridded Data Server component diagram
OGC Services - GeoServer

A key role inside the Gridded Data Server is played by services such as WCS/WMS/WFS/WPS which are registered and classified within the registry at startup according to OGC ebRIM profile standard naming conventions. The Gridded Data Server integrates a customized distribution of the open source geospatial server called GeoServer which provides OGC WMS, WFS and WPS services in order to provide capabilities of ingestion and management of OGC services and geospatial datasets. The WPS (Web Processing Service) is an OGC service able to issue some processing algorithms on the input data. As an instance the GDS is able to extract vector features from raster data by using some IDL algorithms through the WPS protocol.

OMAR ebRIM customization

The Gridded Data Server employs a spatially enabled version of the open source implementation of the ebXML registry specification called Omar version 3.1 in order to allow the search, discovery and registry of geographic datasets and services. A Gridded Data Server user is allowed to, either by using the GDS-UI Prototype user interface or programmatically, search the registry for services and data and to apply operations on the data like download to a specific FTP server, replication onto another GDS or, for raster
data via WCS retrieval, feature extraction using IDL software. The datasets produced by these operations are then registered with the ebXML registry. Such a registration is fundamental in order to be able to include such datasets in future searches performed against the ebXML Registry.

The Gridded Data Server employs on a version of Omar that has been customized in order to be able to efficiently ingest and manage georeferenced data\(^9\). This customized version is shipped with the OGC ebRIM catalog profile already ingested which transforms Omar into a geospatial catalogue. Moreover, further extensions have been submitted to the registry in order to create a specific ebRIM ObjectType for a Job as well as to create the ClassificationNodes used to create intramural associations between a job and its execution status in a standard manner. This would allow clients to discovery Jobs' progress using a standard classification scheme.

**JPIP Server**

One of the main components of the Gridded Data Server is the JPIP server whose role is to allow users to access large, high resolution datasets in a timely fashion under any bandwidth conditions due to its flexible data stream management capabilities. The JPIP\(^10\) server is a fully fledged J2EE application which makes use of a mix of servlets and Stateful Session beans to handle the JPIP code-stream. It is worth pointing out that it uses a PostGIS database as a back-end to store information about the server datasets. The JPIP capabilities are provided via the ITT IAS 1.5 server.

**FTP Server and watch folders**

The GDS exposes an embedded FTP service which is configurable from the JMX console of JBoss as shown in Illustration 4. Via the FTP service, input datasets can be uploaded to the ingestion and conversion engine in order to be ingested into the system and converted to JPEG2000 for later JPIP retrieval. The FTP service users can be managed as well via the JMX console of JBoss. It is worth to point out that each user can be assigned its own JPEG2000 profile which would provide fine control over the conversion process itself. It is also worth to point out that the FTP service limits the data management to the connected user home directory only, so that every user has its own data space on the mass storage isolated from the others.


An additional mechanism to send data to the GDS is provided via Watch Folders. A periodic job is run every 30 seconds to check if new data is available inside the folders configured by the users. In case of new data available, the ingestion and conversion mechanism is automatically started. Every time a dataset is ingested on the system an MD5 Checksum is computed. The checksum is used by the GDS every time a user performs an upload or a replication of the data in order to avoid the ingestion of corrupted datasets into the system.

Watch Folders can be administered via a specific user interface, as shown in Illustration 5, which is integrated in the JBoss JMX console.
JNX MBean View

MBean Name: Domain Name: QDS
service: WatchFolderConfiguration
MBean Java Class: com.itus.ejb.poj.watchfolder.WatchFoldersManagement

MBean description:
Information on the management interface of the MBean

List of MBean attributes:

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Access</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WatchFolders</td>
<td>java.util.List[1]</td>
<td>[]</td>
<td>Attribute exposed for management</td>
<td></td>
</tr>
<tr>
<td>JP2Profiles</td>
<td>java.util.List[1]</td>
<td>[]</td>
<td>Attribute exposed for management</td>
<td></td>
</tr>
</tbody>
</table>

List of MBean operations:

void addWatchFolderRole()
Operation exposed for management

<table>
<thead>
<tr>
<th>Param</th>
<th>ParamType</th>
<th>ParamValue</th>
<th>ParamDescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1</td>
<td>java.lang.String</td>
<td></td>
<td>(no description)</td>
</tr>
<tr>
<td>$2</td>
<td>java.lang.String</td>
<td></td>
<td>(no description)</td>
</tr>
<tr>
<td>$3</td>
<td>java.lang.String</td>
<td></td>
<td>(no description)</td>
</tr>
<tr>
<td>$4</td>
<td>java.lang.String</td>
<td></td>
<td>(no description)</td>
</tr>
<tr>
<td>$5</td>
<td>java.lang.String</td>
<td></td>
<td>(no description)</td>
</tr>
</tbody>
</table>

void deleteWatchFolder()
Operation exposed for management

<table>
<thead>
<tr>
<th>Param</th>
<th>ParamType</th>
<th>ParamValue</th>
<th>ParamDescription</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1</td>
<td>java.lang.String</td>
<td></td>
<td>(no description)</td>
</tr>
</tbody>
</table>

Illustration 5 Administration interface for WatchFolders

Gridded Data Server User Interface
The Gridded Data Server delivers a web client for the discovery and exploitation of the data managed by the server itself. The web client provides functionalities to browse the geospatial information in an intuitive way by connecting to the ebXML registry through JAXR which is a standard, vendor neutral API abstracted from the underlying XML registry implementation. This delivers the possibility to run GDS-UI on a different machine from that which the system resides as well as the option to decouple the user interface from the actual registry vendor.
The functionalities provided by the GDS user interface can be summarized as:

- Role based Authentication & Authorization
- Advanced search and filtering capabilities of the ingested dataset and services
- Capabilities to upload and convert data
- Capabilities to perform IDL Feature Extraction on the uploaded data
- Capabilities to download ingested dataset to a specified FTP service
- Capabilities to replicate ingested datasets to a target GDS

Some of these capabilities are depicted in the pictures below.
Gridded Data Server Job Service

The most important component within the Gridded Data Server is represented by the JobService which provides capabilities to ingest data inside the GDS, export data onto another GDS and perform operations like feature extraction on the ingested data.

The Job Service works in a workflow fashion and provide the capability to ingest data into the GeoServer, to convert the uploaded dataset to JPEG2K, to ingest it into the JPIP server and, eventually, to register the output of the conversion in the GeoServer as well. It is also possible to perform an unsupervised Feature Extraction algorithm on raster data served via the internal WCS as well as to replicate part of the Gds content onto another GDS. It is worth to notice that the progress of each job as well as the various involved parties (services and datasets) are registered in the GDS ebRIM registry in order to allow users to query the system for the status of a submitted Job.

As depicted in Illustration 8, the JobService workflow traverses various statuses which we are now going to explain. It is worth to point out that a Job can be triggered with various actions, currently only the actions implemented are ADD, DELETE, PROCESSING, DOWNLOADING and REPLICATING. The ADD actions triggers a Job to actually ingest the provided dataset in all the GDS services as well as to register it inside the ebRIM registry. The DELETE action can be used to cancel to effects of a previous successful Job. The PROCESSING action is issued to start a data processing throughout the GeoServer WPS service. The DOWNLOADING action is used to allow the GDS pushing selected datasets into a remote FTP server as specified by the user.
throughout the Job Options. The REPLICATING action finally allows the GDS to send the selected datasets to another remote GDS as specified into the Job Options.
GeoSolutions has been contracted in order to support the development of the Global Information and Early Warning System (GIEWS) Workstation project also known as Fenix.

Fenix is a geospatial enterprise framework which aims to provide users with a comprehensive set of tools which would make possible to quickly and easily keep the world food supply/demand situation under control and be informed in near-real time of critical situations around the world. A user friendly graphic interface accessible via standard web browsers, allows users to create customized maps specifying refined rules and constraints, to easily perform rough analysis on the available data like color classifications or like the creation reports describing all the non-geospatial information associated to the currently active map.

The software architecture of the Fenix framework is a sophisticated multilayer architecture.

The data management layers relies on PostgreSQL/PostGIS as the database back end and employs Hibernate as the persistence tool of choice. The service layer (or business layer) is a sophisticated Java enterprise middle ware which serves the Fenix business logic and which integrates the Geonetwork open source framework for the management of metadata as well as the GeoServer open source framework in order to manage geospatial data. The functionalities offered lists reporting generation, advanced collaborations tools, warnings generation. The client tier, or presentation tier, is based on ext-GWT technology and EXT-JS framework extension as well as on the OGC compliant Openlayers client. GWT is used in order to glue together single independent javascript components based on EXT-JS as well as on Openlayers.

The GeoSolutions team is mainly responsible for the integration and customization of the GeoServer framework within the Fenix architecture as well for the development of the geo-mapping interface, developing custom geospatial Javascript widget based on the ext-JS and Openlayers library. Specifically, GeoSolutions developers have integrated GeoServer with the Fenix web services and have written part of the GeoServer REST administration interfaces through which Fenix is able to communicate with it.
It is worth to point out that as a consequence of the development on the client tier GeoSolutions team has decided together with the OpenGeo team (the leading team for the GeoServer) to start up a new open source project called GeoEXT focused on building EXT-JS and Openlayers extension for the GIS data management. It is foreseen that the project will be released to the public in late 2008. GeoEXT pure javascript widgets are fully reusable and pluggable, and easy to extend. The deep knowledge of GeoServer and OGC protocols allows GeoSolutions developers to create strong and powerful GeoEXT widgets that can be integrated into JS based GIS clients to provide very smart functionalities.

As an instance the SLD Editor (see Illustration 9 and Illustration 10) widget is able to recognize the rules of an SLD and dynamically creates an editor panel which guides users to the customization of all the GIS layer style parameters, like outlines, fill colors, opacity and much more.

As an example in Illustration 9 the Polygon Symbolizer widget is represented, is filled with the properties of a Polygon Symbolizer. The user can choose to enable/disable the polygon outline and fill properties. Both allow to choose a color by clicking the “Color Picker” button which shows a nice color picker represented in the picture below. There is also the possibility to setup the opacity of the color through a nice slide bar tool which reports the values in percentage.

The SLDEditor can be populated directly by providing a file containing the original SLD and can also interact with a GeoServer instance through its REST interface. The editor provides functions to automatically
retrieve the SLD of the selected GIS layer via REST, as well as to send back the GIS style and properties to the GeoServer instance. Both the input and output SLDs have to be fully compliant with the OGC SLD 1.0 schema. The SLDEditor works also with raster data. Illustration 11 below shows the result of a RasterSymbolizer applied to a raster DEM managed through the SLDEditor interface. GeoSolutions provided also WebServices for the upload and preprocessing of shapefiles as well as geotiff file as part of an existing workflow withing the Fenix infrastructure.

![Illustration 11 RasterSymbolizer at work](image11.png)
GeoSolutions has been contracted in order to develop a SAS Mission Manager.

NURC’s MUSCLE system is an AUV equipped with a Synthetic Aperture Sonar (SAS) and signal processing units, which allows to scan the sea bed and do analysis of SAS imaging performance, Automatic Target Recognition techniques. A SAS Mission is composed of:

- A set of Data acquired by the vehicle’s equipment along a track which is composed of different legs, each one exposed as a set of matlab files containing data for each tile of the LEG.
- Additional metadata information about the Mission.

This set of information is summarized in Illustration 12

**Illustration 12 Mission Data Package**
The software will be able to coherently ingest and manage SAS Mission Data along with the relevant metadata leveraging on a layered architecture as depicted in Illustration 13.

**SAS Manager Architecture**

The SasManager architecture is mainly composed of a 3 tier layers.

A first data ingestion tier will be responsible for ingesting and pre-processing mission data in order to ingest and catalogue original raw data, perform mosaic balancing as well as storing the mission metadata and relationships in the domain model. Data ingestion is based on a framework which allows reading Matlab 5 file format data tiles by means of a specific MAT5 ImageReader and build a geotiff mosaic on top of them, leveraging on JAI-ImageIO operations integrated within an ingestion engine (GeoBatch).

The middleware tier is responsible for implementing the logic of the application, which means for managing the information acquired during the mission in a manner capable to retain all the relationships between the various elements of the identified domain model. This tier is being built around a customized version of the GeoServer 2 framework which leverages on a catalogue database based. It is worth to notice that the SAS Mission Manager web application is split between the middleware and the presentation tier, since part of it will implement the business logic for our application but will also provide for its user interface. A long term
vision of the software will allow for distributed enterprise architecture capable of managing and disseminating data and information which describe SAS Missions with some key concepts:

1. allow for desktop as well as web-based clients to interact with the system

2. a catalogue/registry component should be part of the SAS Mission Manager architecture in order to
   - allow for refined, keyword and semantic based searches
   - allow for service publishing and subscribe

It is worth to highlight the fact that the backbone of the SAS-Manager is represented by the ServiceMix ESB which act as both an integration framework as well as a middleware/broker between the different services (see Illustration 14).

Illustration 14 ESB as the SAS-Manager backbone

Illustration 15 shows part of a mosaic of several SAS tiles (5) belonging the same LEG.
Lastly, the presentation tier layer allows users to interact and get access to the catalogued data via a Graphical User Interface based on geoSDI-ERA. That GUI allows to configure a connection to a running Geoserver instance (or more) in order to get access to both the ingested raw data and the mosaicked image. Users may browse the data provided and exposed as a tree-hierarchical structure (Data is organized by date, mission, leg, channel), by the Geoserver instance handling the data catalogue. The selected data may be displayed as a map (see Illustration 16).
In order to assist the detection operations, it is possible to zoom and select a region of interest from a rendered mosaic and retrieve and visualize all the original raw data tiles which contributed in building the mosaics for that zone as depicted on Illustration 17. Users may finally get a copy of that raw data.
Illustration 17: Getting raw data
LogiteCNA – Intelligent Transportation System

<table>
<thead>
<tr>
<th>Information</th>
<th>POC</th>
<th>Timeline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Liberologico Srl</td>
<td>Dott. Paolo Lanari, <a href="mailto:p.lanari@liberologico.com">p.lanari@liberologico.com</a></td>
<td>01/01/09</td>
<td>30/09/09</td>
</tr>
<tr>
<td>For:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Regione Toscana</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* Provincia Pisa</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>* CNA Pisa</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Java, JMX, ESB, JavaScript, Groovy, XML, XSD, SOAP, WSDL, JAXB, REST, Java Enterprise, Hibernate, Spring</td>
<td>• Ing. Alessio Fabiani</td>
</tr>
<tr>
<td>• Apache HTTP, Apache Tomcat, Apache ServiceMIX</td>
<td>• Ing Emanuele Tajariol</td>
</tr>
<tr>
<td>• GeoServer, GeoTools</td>
<td></td>
</tr>
<tr>
<td>• PostGIS, Oracle</td>
<td></td>
</tr>
<tr>
<td>• RFID, OpenStreetMap</td>
<td></td>
</tr>
</tbody>
</table>

LogiteCNA is a ITS (Intelligent Transportation System) architecture for tracking outdoor of vehicles and parcels/materials. The project has been developed has part of a larger system for the Province of Pisa for the realization of an experimental RFID and WI-FI systems deployment field for monitoring of materials and vehicles and their tracking on the urban area. The goal of this project was to improve stocks security and delivery as well as to mitigate the urban traffic congestion with the employment of ITS (Intelligent Transportation Systems).

In order to achieve the above mentioned goals, GeoSolutions, in cooperation with LiberoLogico, has developed an LBS framework called RUOTA (see Errore. L'origine riferimento non è stata trovata.) with nfo-mobility capabilities able to ingest, manage and retrieve real time information coming from vehicles transponders and GPS systems deployed on the Pisa urban area. The RUOTA framework provides to the end user advanced mobility tools like geocoding and reverse geocoding, routing and also statistical instruments in order to help estimate possible traffic congestion areas and more.
Illustration 18 LogiteCNA Architecture
RUOTA is a complex SOA (Service Oriented Architecture) fully based on ESB (Enterprise Service Bus) and web services. As depicted in the diagram above, the different RUOTA components are wrapped into Service Units\(^{11}\) directly attached to the ESB which allows the exchange and routing of normalized XML messages through message queues among them. The Binding Components\(^{12}\) allow external actors and users to invoke RUOTA operations and instrument complex process workflows in order to obtain the information requested. The security subsystem is built upon JAAS (Java Authentication and Authorization Services) and integrated with the RUOTA RUOTA. All the GIS functionalities are provided by GeoServer.

RUOTA architecture consists of various components each one conceived as a service of the SOA, thus allowing components to be plugged/un-plugged and distributed in order to be integrated on other similar architectures or configurations.

The components built for RUOTA at this time are the following:

\(^{11}\) In the ServiceMix framework a Service is the actual business entity that performs the desired function. Service units provide information about the services and their endpoints to the component.

\(^{12}\) In the ServiceMix framework the primary purpose of the components is to let the services interact with the NMR (Normalized Message Router) and vice versa. A Binding Component basically is an interface allowing this kind of interactions thought some specific transport protocol (HTTP, SOAP, ...).
• Authentication, Authorization and Accounting endpoints
• RUOTA, router and connector endpoints
• Statistics endpoints
• GeoCoding and Reverse GeoCoding endpoints
• Routing endpoints

We are going now to provide a brief description of the components listed above.

Authentication, Authorization and Accounting
The ESB JAAS module used by all the Service Endpoints to authenticate and authorize users, has been fully customized in order to retrieve Roles and Users information directly from the RUOTA DataBase, thus allowing the Service Endpoints directly interacting with the DB, such as the Statistics one, to produce/filter results/data for specific Roles/Users. The whole DB interaction has been achieved through JPA and Hibernate framework.

RUOTA, router and connector
This is one of the core RUOTA modules, basically it is delegated to receive messages from the RFIDs and vehicle Black-Boxes and appropriately register all the events on the RUOTA DataBase. This module also maintain the events and reports history, and updates the GIS tables in order to be efficiently and reliably used by the geospatial server GeoServer.

Statistics
This module computes statistics and produces appropriate density maps upon the events registered by the RUOTA endpoints (see Illustration 20).

The service exposes some methods allowing administrators and users to configure several kind of statistics on the RUOTA events. A statistic is composed basically by:

- The kind of statistics (count, average, etc.)
- An area of interest
- A temporal interval
- A range of event types
- The grid resolution

An administrator can issue the statistic computation every time, but also a configurable Quartz scheduler integrated into the system, rebuilds all the configured statistics on a periodical fashion. The users can interact with the statistics configurations and GIS layers outcomes directly from the RUOTA interface.
GeoCoding and Reverse GeoCoding

This kind of service provides functionalities of Geo/ReverseGeoCoding, i.e. the possibility to the user to request the coordinates of a certain named location or a point of interest (GeoCoding) or vice-versa to retrieve all the point of interests around a specific location (ReverseGeoCoding).

The Service has been conceived as a fully pluggable system where different GeoCoding providers can be specified. As an instance the system can use the Google and the OpenStreetMap GeoCoding engines by attaching to the Service the two appropriate plugins.

Once running, the Service will issue users’ requests to the attached providers and automatically assign weights to the providers’ responses. This because some providers do not allow more than a specific limited number of requests per day or maybe they are often overloaded and the response times can be quite long. In such way the GeoCoding Service is able to provide reliable responses quickly.

Routing

The Routing service is delegated to compute routes against different methods and algorithms over the city road network graph. This service was built by creating an improved REST interface on top of pgRouting framework and inherits its functionalities. It provides basically two interfaces, one allowing to compute the
closest graph edges against a certain location coordinates and another one allowing to compute the best route against some provided edges and specific routing algorithm.
Support for FAO Fishery Department activities

<table>
<thead>
<tr>
<th>Client</th>
<th>POC</th>
<th>Timeline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN FAO, FIGIS Dept</td>
<td>Dott. Marc Taconet, <a href="mailto:marc.Taconet@fao.org">marc.Taconet@fao.org</a></td>
<td>02/2009, ongoing</td>
<td>In Progress</td>
</tr>
</tbody>
</table>

Technologies
- Java, C++, JMS, JMX, ESB, JavaScript, Groovy, XML, XSD, SOAP, WSDL, JAXB, REST, Java Enterprise
- Apache HTTP, Apache Tomcat,
- GeoServer, GeoTools, GDAL, GeoWebCache, OpenLayers, Ext-JS
- PostGIS, Oracle

Staff
- Ing. Alessio Fabiani
- Dott. Tobia Di Pisa
- Ing. Emanuele Tajariol
- Dott Lorenzo Natali

Starting from beginning 2009, GeoSolutions established a working relationship with the Fishery and Aquaculture Department of FAO in Rome, refactoring and/or developing most of their GIS statistical and web applications.

The mission of the Fisheries and Aquaculture Department of FAO is to facilitate and secure the long-term sustainable development and utilization of the world's fisheries and aquaculture. FAO is acutely aware of the fundamental social and economic role played by these two sectors in:

- Meeting global and national sustainable food security.
- Providing self and paid employment for fishing and aquaculture related communities as a means of alleviating poverty in these fishing communities and stemming rural/urban drift.
- Contributing to national and international trade.
- Generating national income.

Underpinning these basic social and economic objectives is the requirement for fisheries and aquaculture to be responsibly managed. This implies preventing overfishing, promoting sustainable aquaculture, coordination and delivery of effective research and extension and the empowerment of people, especially women tasks for which many FAO Members are not fully prepared. The Fisheries and Aquaculture Department therefore provides, on the request of Members, technical assistance in all aspects of fisheries and aquaculture management and development.
The Department promotes policies and strategies aiming at sustainable and responsible development of fisheries and aquaculture in inland and marine waters. For this purpose, the Department provides discussion fora, information, legal and policy frameworks, codes and guidelines, options for strategies, scientific advice, training material, etc. For the purpose:

- It collects, analyzes and disseminates information on the sector operations (catch, production, value, prices, fleets, farming systems, employment).
- It develops methodology, assesses and monitors the state of wild resources and elaborates resources management advice.
- It monitors and advises on the development and management of aquaculture.
- It provides socio-economic analysis of fisheries and aquaculture and assists in the elaboration of development and management policies and strategies and institutions.
- It supports and assists a network of regional fishery commissions and promotes aquaculture networks.
- It monitors and advises on technology development, fish processing, food safety and trade.

We are now going to briefly describe the most interesting projects GeoSolutions have been working on for the FAO Fishery Department. They are briefly described here below, while more details are provided in the following sections:

- **GeoServer as geospatial DataBase for FIGIS spatial datasets**: The FI department is producing a wide set of geospatial data representing the base and the core of the FI work, like FAO Areas and Divisions, Fishery Areas, Species Distributions and Stocks, Economic an Jurisdictional Areas, and many more. One of the main concerns of the FI department was to make all the geospatial datasets available both for the FAO departments and for FAO member countries. The FI dept choice was to create a geospatial data infrastructure based on the OGC services Web Map Service, for the maps generation, Web Feature Service and Web Coverage Service, for the raw vectorial and raster data dissemination. The OGC Web Services implementation chosen was GeoServer which actually is mounted as reference FI instance linked to an Oracle DataBase with Spatial Extension containing the whole FI dept geospatial dataset. As a plus most of the important gis layers have been described and exposed on the official FAO Web Catalog Service implemented by GeoNetwork and directly linked to the FI GeoServer instance.

- **GeoWebCache for map layers optimization**: With the exposure of the geospatial data to the web, in particular of the maps, the FI dept had to face another issues caused by the needing of optimizing the maps generation and streaming in order to avoid the server overload and to ensure good performances and low response times to the users. To achieve this goal we helped FI dept to enable and configure a map caching tier built with GeoWebCache other than applying an amount of...
optimization both at back and front end levels. The results are light, quick and responsive GIS clients providing high quality maps to the end users.

- **Dynamic maps on FIGIS resources fact sheets**: GeoSolutions developed a set of JavaScript/AIDS APIs which FI dept web designers have been successfully used to easily integrate fully dynamic maps on the FI resources fact sheets. What before were static images representing the resources distribution and limits, now are pretty dynamic and interactive maps. The JavaScript APIs have been developed having in mind simplicity of use and reliability. With just one line of code the web designers have been able to enable dynamic maps on the pages.

- **Dynamic rendering of Regional Fishery Bodies areas**: Similar to the previous point, GeoSolutions has created APIs to fully dynamically render the Regional fishery Bodies Areas. We also allow the rendering for some special cases where particular projections were required, like the Polar Stereographic and the Spherical Mercator Pacific Centered ones.

- **Tuna Atlas and Billfish catches statistical application**: The interactive version of the Atlas presents the global distribution of 1950 to 2008 catches, at 5° latitude by 5° longitude resolution, of those tuna and tuna-like species for which this distribution is generally well known on the global scale. These species consist of the so-called principal market tunas and some billfishes. The first version of this application representing dynamic statistical data was presenting to the user static gifs of the outcomes. GeoSolutions has designed and developed a new complex architecture based on GeoTools/GeoServer stack capable of generate dynamic statistical datasets on the fly. This is possible thanks to a brand new GeoTools plugin developed by GeoSolutions able to create virtual datastores on the fly relying on some aggregation parameter which GeoServer can use than to dynamically render the maps through the WMS. The result is an interactive map representing dynamically computed statistical information, also allowing users to querying the cells and obtain details on the values and breakdowns.

- **Vulnerable Marine Ecosystem Database**: The Vulnerable Marine Ecosystem Database (VME-DB) gathers information on VME areas stored in harmonized way and disseminated through maps and fact sheets. For background information

GeoServer as geospatial DataBase for FIGIS spatial datasets
GeoSolutions helped out FI dept geospatial analysts and system administrators to deploy and optimize a fully operational OGC services based infrastructure in order to manage and deliver geospatial datasets to FAO and partners provided by FI Oracle spatial databases.

It is worth to point out that a big amount of custom optimizations have been achieved considering the FI available hardware and stuff other than performance/reliability requirements like traffic and users accesses to the spatial resources (see Illustration 21).
**GeoWebcache for map layers optimization**

GeoWebCache is a system such as TileCache or Squid to improve the performance of display of maps and optimize the delivery of content. It has been included into GeoServer from the 1.7.0 version.

GeoSolutions helped out FI system administrators to install and configure GeoWebCache instances in order to optimize the background layer dissemination avoiding to overload the geospatial server instances, experiencing a quite high map production performance increment (see Illustration 22 and Illustration 23).
Capture fisheries and aquaculture depend on the use of natural renewable resources and other resources (e.g. aquatic species, land and water) as raw material. Other resources such as hatchery-produced seeds, feeds and fertilizers are artificially generated. Because fishery resources are finite, there is competition for them, within the sector and with other types of uses. Aquaculture resources comprise a wide variety of animals and plants (and their genetic resources) such as fish; crustaceans, mollusks, seaweeds and other...
aquatic plants. The primary aim of the Fishery Resources Monitoring System (FIRMS)\(^{13}\) is to provide access to a wide range of high-quality information on the global monitoring and management of fishery marine resources. FIRMS system is part of the Fisheries Global Information System (FIGIS). Information provided by the partners is organized in a database and published in the form of fact sheets. This system provides the data owner with tools to ensure controlled dissemination of high quality and updated information.

For the enhanced mapping support to resources fact sheets, GeoSolutions has developed a JavaScript API based on GeoServer/OpenLayers which allows DHTML/XSD FIGIS developers to easily build up dynamic maps representing the desired FIGIS GIS resources. The JavaScript framework not only allows to specify a custom set of GIS Regional Fishery Bodies layers, but also attribute filters and dynamic styling. As stated above it is worth to point out that the whole framework is based on OpenLayers and GeoServer.

Illustration 24 represents a resource fact sheet for the species *Gadus morhua* containing the map created through the JavaScript API and provided by GeoServer. The map contains several layers from different geospatial datasets like the species distribution in red, the FAO areas transparent with dashed stroke, FAO divisions in blue etc...

**Regional Fishery Bodies Viewer**

Regional Fishery Bodies (RFBs) are a mechanism through which States or organizations that are parties to an international fishery agreement or ("agreement" is fundamental, and different from arrangement) arrangement work together towards the conservation, management and/or development of fisheries. (Some RFBs, especially those with an ecosystem mandate, work with seabirds, etc that are connected with fisheries but are not fish stocks per se.) The Regional Fishery Bodies summary descriptions provide basic information on each of about 40 established Regional Fishery Bodies (FAO and non-FAO RFBs) that cover the world's marine and inland regions. The collection of RFBs summary descriptions was designed to facilitate users understanding of worldwide Regional Fishery Bodies. The FAO Fishery department has created a static collection of RFBs\(^{14}\). The collection contains the RFBs Fact Sheets and each sheet contains a static map representing the RFB area (competence, regulatory or geographic) and limits.

GeoSolutions helped out FI dept to create an enhanced GeoServer based geospatial database capable of automatically render the RFB maps along with the dynamic legend and a lot of interactive functions. An enhanced set of JavaScript APIs allow FI dept web designers to easily and quickly activate interactive RFB maps into the Fact Sheets as shown in the figures below.

\(^{13}\) [http://firms.fao.org](http://firms.fao.org)  
As a proof of concept of the FI RFB mapping capabilities, in the same Fact Sheet for CECAF RFB both the static gif map and the dynamic one have been enabled (see Illustration 25). Here below you can find some screenshots from the final prototype (Illustration 26 and Illustration 27).

Illustration 24 Resource fact sheet for the species Gadus morhua
Illustration 25 RFB early prototype
Tuna Atlas and Billfish catches statistical application

The Interactive Querying and Displaying of Tuna and Billfish Catches application presents to the user a tab panel where it is possible to select the tuna species, the type of gears and the year quarters where to compute dynamic statistics of the total or average catches around the world (see Illustration 28).

The statistical generated map is dynamic, and represents on a 5x5 deg grid the light map of the catches values. Moreover the user can obtain information on the statistical value and species breakdown directly by clicking on the grid (see Illustration 28).

Illustration 28 Tuna Atlas Front End

It is worth to point out that the whole application is based on advanced usage of OpenLayers and GeoServer Open Source products.
Support for FAO CIOK Department

<table>
<thead>
<tr>
<th>Client</th>
<th>Information</th>
<th>POC</th>
<th>Timeline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN FAO, CIOK Department</td>
<td>Dott. Karl Morteo, <a href="mailto:Karl.Morteo@fao.org">Karl.Morteo@fao.org</a></td>
<td>12/01/2009</td>
<td>Ongoing</td>
<td>In Progress</td>
</tr>
</tbody>
</table>

Technologies

- Java, C++. JMS, JMX, ESB, JavaScript, Groovy, XML, XSD, SOAP, WSDL, JAXB, REST, Java Enterprise
- Apache HTTP, Apache Tomcat
- OGC Protocols and Specifications
- GeoServer, GeoTools, GDAL, GeoWebCache, GeoBatch, OpenLayers, Ext-JS
- PostGIS

- Ing. Simone Giannecchini
- Dott. Andrea Aime
- Ing. Emanuele Tajariol
- Dott Carlo Cancellieri

GeoSolutions has been contracted by the CIOK department of FAO in order to provide expertise in developing geospatial services. As a first requirement we worked on WPS process for computing statistics on vector and raster layers on cells values (for raster) or on a specified attributes (for vector). The areas delimiting the units to be considered the object of the statistics can be circular buffers, or server-stored polygons.

The provided statistics are:

3. minimum value;
4. maximum value;
5. values range;
6. average;
7. standard deviation;
8. sum.

Platforms involved

In a logic of integration, the work has been implemented on the same platform the customer was using, that is GeoServer 1.7.4.

The statistic vector part makes use of the existing API in GeoTools 2.5.5 (which is the version used by GeoServer 1.7.4), and has been totally implemented in the WPS process submodules.
The development on the raster part was more complex, since basic stats operation had to be implemented into the JAI-Tools libs, and then bridged through GeoTools, which had to be modified as.

WPS processes

Main input parameters for the processes are:

- one or more area geometries that delimit the zone where stats are to be computed;
- one or more data layers, that contains the data that will be computed.

The two processes deal with the different ways to define the areas: the BufferZonalStats will consider circular buffers, while the ZonalStats will use polygons selected from a vector layer.

Data layers may be:

- vector – in this case the attribute name on which perform the calculations is required. A CQL filter may be optionally given, in order to compute stats only on a subset of the features. Feature geometries may be polygons, lines or points.
- raster – here the band index(es) may be optionally provided to the process, on which perform the calculations.

ZonalStats process

The ZonalStats process computes statistics on a set of polygons. These polygons are defined as features in a given layer. A CQL filter may be given in order to compute statistics only on a subset of the polygons defined in the layer.

The process response will return the statistic values, one for each selected feature in the area layer, for every data layer.

As an example, let's consider here a polygon data layer. The CQL filter selects the green polygons.

Illustration 30 Infrastructure of CIOK WPS
The area layer contains 3 polygons, and the area filter selects 2 of them (A and B).

The output will contain a total of two entries: 1 data layer times 2 area polygons.

“A” will hold the statistics of the two intersected area polygons, while the entry for “B” will state that there are no polygons involved in the computation.

**BufferZonalStats process**

The **BufferZonalStats** process computes statistics on a set of concentric circles. Such circles are provided to the WPS process as the coordinates of the center and a list of radii expressed in Km. The process response returns the statistic values, one for each circles, for every data layer.

**Data.fao.org Infrastructure**

One of the tasks on which GeoSolutions is working on with the FAO CIOK department is the implementation of next generation spatial data infrastructure that will serve geospatial and statistical data to the entire FAO and will be based on. In Illustration 31 an initial design is shown. The current beta version can be reached at this link.

---

Illustration 31 FAO CIOK Department future architecture
The purpose of this project was the development of a web architecture for allowing the management and visualization of geospatial data collected during NURC scientific cruises by various instruments and sensors. The data produced in this context was to be ingested into a database and made available through a user interface in order to interact with the data itself for a subsequent analytical studies phase.

A **Glider** is a type of probe which is used to perform specific measurements in open sea water. The measurements performed by a glider depend essentially on the kind of sensors with which it is equipped, and they deal with the water temperature, salinity, pressure, water density, conductivity and other geophysical parameters. Typically a glider with its measurement's instruments is released in the water to perform a predetermined route under the sea's surface. During the whole route the glider proceeds moving between two intervals of depth, which are determined emerging periodically to transmit the data via GPS device with which it is equipped (the time period during which the glider is under the sea's surface is decided before it is released in the water).

During the post process phase (at the end of the mission) the positions sent to the glider are interpolated using the available data; this permits to associate every measurement with a point in the 3D space (latitude, longitude and depth) and with an exact temporal moment. The set of the information resulted from this phase of post process is inserted into a file netCDF to which is associated an ipercube of data.
The **Ocean Profile** data is acquired from the CDT/XBT probe which allow the management of the several geophysical parameters.

The Ocean Profiles basically are objects which associate to a geographic location, usually expressed in longitude and latitude, some information concerning different measurements performed on that point during NURC cruises.

An Ocean Profile basically is a small dataset which represents the measurements of several parameters (Pressure, Salinity, Temperature, ...) at a certain date and time, a certain position (longitude, latitude), at different water depths by a sensor deployed on an instrument during a cruise.

We can see an Ocean Profile as composed by two main sections:

1) An “header” where generic information like the cruise name, the ship, the sensor the position and so on are stored. Those information are very useful to perform standard queries about Ocean Profiles on a database or to plot it on a map. It is correct to say that the header represents the Ocean Profile Meta-Data.

2) A “body” where all the physical measurement data is stored.

In order to ingest the gliders and the ocean profiles (named observations) measurements into PostGIS database the GeoSolutions GeoBatch framework has been used.

In GeoBatch a specific ingestion flow has been created for ingest the netcdf input files (Gliders data) and .dat input files (Ocean Profile data) into database. The input files have been processed to retrieve the data (time, position, parameters, unit of measurement and sensor measurements etc.). The data read by the files are subsequently distributed in the charts of interest according to the logic of the data base selected model, respecting the constraint and the dependences specified by the scheme.

In order to export the Oceans Profiles and Gliders information via web an application JavaScript based on ExtJs and Openlayers is used. This application deals him with to visualize the points of the observations through a layer of GeoServer built on a sight on purpose predisposed in the data base.
The web interface furnishes some functionalities that allow to specify filters for the visualization of the points in the map and to export the kml for their visualization on Google Earth (in this case the use of the particular template in GeoServer performs animations in the time and also visualize the data under the surface of the sea).

Through specific commands the web interface can send specific request via REST to a server application. The REST server application return various information questioning the data base (in JSON format, in text format or in netCDF format in base to the request).

The data that the REST application can return they concern both the measurements effected by the probes both information related to the ships, the cruises, the scientists and the projects. The server REST application can export data measurement from the data base (Gliders and Oceans Profiles). Through the use of the web interface, for example, the user can be require the data measurements via REST and this are returned in zip format. The file archive can contain file in .txt format for the Oceans Profiles, in netCDF format for the Gliders and the kml format to allow the Google Earth visualization.

Illustration 34 Web GIS front-end application
Illustration 35 Glider view in Google Earth

Illustration 36 Glider view in Google Earth (view under the surface of the sea)
E-GEOS Sistema Informativo Agricolo Nazionale (SIAN)

<table>
<thead>
<tr>
<th>Information</th>
<th>POC</th>
<th>Timeline</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>E-GEOS</td>
<td>Dr Marco Corsi</td>
<td><a href="mailto:marco.corsi@e-geos.it">marco.corsi@e-geos.it</a></td>
<td>Begin 01/11/10, End 01/06/11, Status Completed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Java, JMS, JMX, JavaScript, Groovy, XML, XSD, WSDL, JAXB, REST, Java Enterprise</td>
<td>• Ing. Simone Giannechchini</td>
</tr>
<tr>
<td>• Apache HTTP, Apache Tomcat, LDAP</td>
<td>• Dott. Andrea Aime</td>
</tr>
<tr>
<td>• OGC Protocols and Specifications</td>
<td>• Ing. Alessio Fabiani</td>
</tr>
<tr>
<td>• GeoServer, GeoTools, GDAL, GeoWebCache, GeoBatch, OpenLayers, Ext-JS</td>
<td>• Dott. Emanuele Tajariol</td>
</tr>
<tr>
<td>• PostGIS, Oracle</td>
<td>• Ing. Daniele Romagnoli</td>
</tr>
</tbody>
</table>

The purpose of this project was the development of a web architecture for allowing the management and visualization of geospatial data collected during NURC scientific cruises by various instruments and sensors. The data produced in this context was to be ingested into a database and made available through a user interface in order to interact with the data itself for a subsequent analytical studies phase.

The purpose of this project is to provide a national wide SDI (Spatial Data Infrastructure) providing WMS, WFS, WCS and CSW services to any OGC compliant client. The data to be published is composed of both raster and vector data.

Raster data is mainly composed of high accuracy orthophotos of the entire Italy, available over multiple years. Each orthophoto mosaic is over 4TB of JPEG compressed GeoTiff tiles, for a total of over 12TB of imagery.

Vector data is composed of a wide variety of layers including the full Tele Atlas road network, hierarchical administrative subdivisions, land use and the like. The most interesting layers are the land use, land parcels, and land use/parcel intersections, which make up the most part of the data in terms of size: the intersection layer is composed of over 150 million records.

Raster data is kept on a NAS, whilst the vector data is distributed among a set of different Oracle RAC databases, which are in turn deployed on a cluster of database machines.

Some layers (orthophotos) do not change frequently and are to be used as map backgrounds in common web-gis front ends with fixed projections, as such they are tile cached on disk via GWC to ensure the...
highest performance. Caching is setup so that only the first 15 zoom levels are pre-computed offline, whilst any tile requested above that level is generated on the fly by GWC making the necessary requests to GeoServer WMS

The system is designed to provide high availability (no single point of failure) and high scalability. The hardware/software architecture is summarized in

First off, an overview of the hardware. The system is composed of two main application servers, DDS1 and DDS2, each of them having 32 cores (using Intel Xeon CPUs) and 32GB of memory. The data storage is divided among multiple RAC instances (each one containing different sub-themes of the data, for example one dedicated to Tele-Atlas road network tables, one with the forestry data, and so on), and a NAS providing data repository storage for all the raw raster data as well as the GWC tiles. All the storage is highly redundant, the NAS using RAID schemes, Oracle using multiple servers with Real Application Cluster setups.

The two application servers hosting GeoServer, GeoWebCache and GeoNetwork offer the same functionality and are load balanced by a hardware, high available load balancer (meaning it’s actually two load hardware load balancer with an active/dormant setup, the dormant node activates only if the active one fails).

The load balancer uses different workload distribution policies depending on the type of request handled. All request but the GWC ones are simply distributed among nodes in a round robin fashion, as OGC services are stateless. The GWC requests for tiles are instead distributed following the active/dormant paradigm: all the requests are sent to the GWC on DDS1 until there is a failure, if that GWC cannot be reached the load balancer redirects all requests to the GWC on DDS2 instead.

The rationale here is twofold:
- GWC requests are mostly dealing with disk access, and in case a new tile is requested GWC is able to round robin necessary WMS requests among the two nodes itself
- Tile storage is for the moment not concurrent access safe, so we need to make sure only one GWC is writing on disk at a specific moment in time

Each DDS server in turn contains one GeoNetwork instance, one standalone GWC, one GeoServer with integrated GWC and three stand-alone GeoServer nodes. The stand-alone GeoNetwork provides catalogue services, whilst the stand alone GWC has been discussed already.

The integrated GeoServer + GWC has the purpose of administration and pre-seeding server. First off, it is used by the administrators to perform changes in the configuration of GeoServer (such as adding new layers, changing styles) which will be then stored on a shared disk in a location separate from the one used by the other three GeoServer instances
When the administrators are satisfied with the updated configuration, they are going to use a script that will copy over the configuration to the location used by the production GeoServers and a script will force all of them to reload the configuration from disk, making the new setup public. This allows for a staging of the changes before they go public and an almost instant switch from old to new configuration.

The second purpose of the integrated GS + GWC is tile preseeding: as new orthophotos are made available, that single instance, at reduced process priority, will take on the load of tile preseeding. This avoids putting extra strain on the production instances and to efficiently generate the tiles as system resources are available (the integrated version allows GWC to build tiles faster as some image encoding/decoding are avoided).

The remaining three GeoServer instances are used for serving production requests. The usage of three instances is justified by the following observations:

- Java2D on Sun virtual machine is fast but has a scalability issue that prevents from efficiently serving more than 4 GetMap requests involving vector data. Splitting the servers allows for better scalability as the different processes won’t synchronize with each other.
- Segfaults in the JVM are rare but not impossible, having multiple instances ensures the available hardware keeps on being used as the crashed instance is identified and restarted.

Each GeoServer is also equipped with the “control-flow” extension which allows the administrator to put hard limits on the number of concurrent requests depending on the type of service, request and client performing it. The limitations are based on the following rationale:

- Each request requires a set amount of memory, which can be large in case of GetMap requests (various megabytes), so there is a physical limit before the server finds itself in a low available heap condition and starts throwing OOM exceptions.
- The available CPUs can efficiently serve only so many threads in parallel, past that number the system effectively thrashes and the overall throughput suffers.
- A single client must not be allowed to dominate the server and exert most of the load, so only a certain number of concurrent requests by the single client must be accepted, whilst the others should be queued.
- In case of high load it’s better to just drop requests that have been queued for a too long time (minutes), in any case the client will have moved on (but that cannot be determined until the request starts to be written).

The “control-flow” thus allows to maximize the resource usage and serving fairness resulting in better stability and lower error counts.

The node also contains a set of watchdog processes that periodically check each of the installed software is available and able to respond requests. In case the server cannot be contacted or appears to be stuck, the watchdog will kill and restart it forcefully, ensuring production continuity even in off hours when the human administrators are not available.
This production model can be easily scaled up to use more DDS nodes in order to achieve any service level agreement. Of course this assumes the data storage is fast enough to cope with the increased load: generally speaking the redundancy level of the data serving level should follow up with the size increase of application server level.

The SDI system also needs sophisticated access control: each user may or may not access a specific layer or a part of it, also certain functionalities (for example, WFS-T) might be limited to certain privileged users. GeoServer security architecture has been upgraded to allow such kind of fine grained control on both vector and raster layers, and a separate system, GeoRepository, has been created to manage the users and their privileges.

Both GeoServer and GeoRepository do interface with an LDAP system to authenticate and locate the users. GeoServer then uses a custom made authorization plugin calling onto the GeoRepository (via web services) to find out what service and data access limitations are in place and then enforces them both at the service access level (as the requests are parsed) and at the data access level (as the GeoServer code tries to access the data contained in the catalog).

GeoRepository provides a web front end based on GWT allowing and administrator to edit the various data and service access rules based on the user roles (RBAC, Role Based Access Control). The common filter types that can be specified are:

- service and method filters to limit what OGC service calls a user can make
- workspace and layer filters allowing a certain user to access only a subset of the available layers
- per row conditions such as attribute based and spatial filtering, allowing the user to only access data in a certain area and satisfying certain attribute conditions
- limit the attributes that a user can see in a certain vector layer
- mix the above rules together to allow service specific data access patterns, for example, allow full attribute access to a GetMap that will classify the data in categories, but negate point specific access to the same attribute values in GetFeatureInfo

Finally the system allows to impose a certain SLD style given the user and a specific layer, disallowing the user from leveraging GeoServer dynamic styling functionalities.
Profile, Past Performance and Professional's Qualifications

Illustration 38 SIAN SDI Infrastructure
Profile, Past Performance and Professional's Qualifications

Illustration 39 GeoRepository Infrastructure
ACQUE SPA GeoPortal

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACQUE SPA</td>
<td></td>
</tr>
<tr>
<td>POC</td>
<td>Begin</td>
</tr>
<tr>
<td>Francesco Branchitta, <a href="mailto:f.branchitta@acque.net">f.branchitta@acque.net</a></td>
<td>01/06/12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise</td>
<td>Ing. Simone Giannecchini</td>
</tr>
<tr>
<td>Apache HTTP, Apache Tomcat</td>
<td>Dott. Lorenzo Natali</td>
</tr>
<tr>
<td>OGC Protocols and Specifications</td>
<td>GeoServer, GeoTools, GeoWebCache, GeoBatch, OpenLayers, Ext-JS, MapStore</td>
</tr>
<tr>
<td>PostGIS</td>
<td></td>
</tr>
</tbody>
</table>

GeoSolutions has been contracted during 2012 in order to develop and evolve over time an integrated metadata portal based on Open Source component as well as in order to take over and conclude the work on the Wiz platform for both user and municipalities planners. It is worth to point out that the Metadata Catalogue at the end of the project will be harvested by the INSPIRE GeoPortal for data and metadata dissemination.

As depicted in Illustration 40 the geoportal has been developed leveraging on the MapStore, GeoServer and GeoNetwork Open Source Projects.
### City of Florence GeoPortal

<table>
<thead>
<tr>
<th>Information</th>
<th>POC</th>
<th>Timeline</th>
<th>GeoSolutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Florence, GIS dept.</td>
<td>Dr. Gianluca Vannuccini, <a href="mailto:g.vannuccini@comune.fi.it">g.vannuccini@comune.fi.it</a></td>
<td>01/11/11 Ongoing In Progress</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise</td>
<td>• Ing. Simone Gianneckini</td>
</tr>
<tr>
<td>• Apache HTTP, Apache Tomcat</td>
<td>• Dott. Lorenzo Natali</td>
</tr>
<tr>
<td>• OGC Protocols and Specifications</td>
<td>• Dott. Tobia Di Pisa</td>
</tr>
<tr>
<td>• GeoServer, GeoTools, GeoWebCache, OpenLayers, ExtJS, MapStore</td>
<td>• Dott. Andrea Aime</td>
</tr>
<tr>
<td>• PostGIS, Oracle</td>
<td></td>
</tr>
</tbody>
</table>

The project aims to bring together in a comprehensive and integrated manner the capability to search, visualize and download the data that the municipality of Florence has released as OpenData supporting the standards mandated by the INSPIRE directive.

During 2012 the project aimed to deploy and use the basic building blocks, GeoServer and GeoWebCache for the dissemination of maps and vector data according to OGC WFS and WMS and WMTS protocols, GeoNetwork to disseminated Metadata according to OGC CSW protocols and ISO 19115/10139 Metadata Standards and eventually MapStore for the integrated visualization of data and metadata.

In 2013 we are concentrating our efforts towards INSPIRE compliance as well as towards the provision of additional services also for real-time data. If time remains we will also start working towards the integration of the geospatial information we are disseminating with the semantic world to allow semantic search and geolinking.
Illustration 41 City of Florence OpenGeoData Portal
### FAO – Fouta Djallon Highlands (FDH) Atlas

<table>
<thead>
<tr>
<th>Information</th>
<th>POC</th>
<th>Timeline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>UN FAO, NRL Department</td>
<td>Dr. Antonio Martucci, <a href="mailto:martucci@gao.org">martucci@gao.org</a></td>
<td>01/06/11 - 01/12/12</td>
<td>Completed</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise</td>
<td>• Ing. Simone Gianneccchini</td>
</tr>
<tr>
<td>• Apache HTTP, Apache Tomcat</td>
<td>• Dott. Lorenzo Natali</td>
</tr>
<tr>
<td>• OGC Protocols and Specifications</td>
<td>• Dott. Tobia Di Pisa</td>
</tr>
<tr>
<td>• GeoServer, GeoTools, GeoWebCache, OpenLayers, ExtJS, MapStore</td>
<td>• Dott. Emanuele Tajariol</td>
</tr>
<tr>
<td>• PostGIS, Oracle</td>
<td></td>
</tr>
</tbody>
</table>

The Fouta Djallon Highlands (FDH) are a series of high plateaus concentrated in the central part of Guinea and extending into Guinea-Bissau, Mali, Senegal and Sierra Leone. This area is the point of origin of a number of transboundary rivers in West Africa, notably the Gambia, Niger and Senegal rivers, as well as a number of small water courses. Due to their geographic and climatic diversity, the highlands and the surrounding foothills support a rich variety of ecosystems.

This project aimed to create an integrated GeoPortal to be used to document geospatial datasets and outputs in the Fouta Djallon Highlands, to help policy makers improve natural resource management in the region. The portal includes elements related to general information on the system, a metadata catalogue for retrieving data, and a WebGIS platform for displaying data. The GeoPortal will be a key tool to document significant geo-spatial datasets and outputs collected by the projects in the area and generate and disseminate high quality information for an improved management of the natural resources of the area.

The architecture for the portal comprise solely of Open Source components: GeoServer is used as the tool for managing and disseminating maps and vector data, GeoNetwork\(^\text{16}\) is used to catalogue and search spatial and non-spatial datasets and eventually MapStore\(^\text{17}\) is used as a WebGis for linking together maps and searches for an integrated user experience. In Illustration 42 the front-end is shown.

---

\(^\text{16}\) [http://geonetwork-opensource.org/](http://geonetwork-opensource.org/)

\(^\text{17}\) [http://mapstore.geo-solutions.it/mapstore/](http://mapstore.geo-solutions.it/mapstore/)
CSI Piemonte - GeoPortal

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>POC</td>
</tr>
<tr>
<td>CSI Piemonte</td>
<td>Silvana Griffa, <a href="mailto:silvana.griffa@csi.it">silvana.griffa@csi.it</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise</td>
<td>Ing. Simone Giannecchini</td>
</tr>
<tr>
<td>Apache HTTP, Apache Tomcat, Shibboleth</td>
<td>Dott. Tobia Di Pisa</td>
</tr>
<tr>
<td>OGC Protocols and Specifications</td>
<td>Dott. Emanuele Tajariol</td>
</tr>
<tr>
<td>GeoServer, GeoNetwork, OpenLayers, Ext-JS, MapStore</td>
<td></td>
</tr>
<tr>
<td>PostGIS, Oracle</td>
<td></td>
</tr>
</tbody>
</table>

The goal of this project is to, on a side, customize GeoNetwork 2.6.x to support the Italian RNDT Metadata standard for INSPIRE and, on the other side to provide user interface customizations to comply with the guidelines from CSI Piemonte. RNDT conformance is checked on both metadata schema and CSW service.

Extensive activities have been carried out to review and propose adoptions of the RNDT standard being developed together with colleagues from CSI Piemonte and DigitPA, but also to improve and customize GeoNetwork whether necessary in order to allow metadata editing and validation using the specific RNDT profile.

It is foreseen a port of the customization to the upcoming GeoNetwork 2.10 release for easier maintenance.
CSI Piemonte – Destination Project

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSI Piemonte</td>
<td>Antonello Navarretta,</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:antonello.navarretta@csi.it">antonello.navarretta@csi.it</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise, JMS, ESB</td>
<td>Ing. Simone Gianneccchini</td>
</tr>
<tr>
<td>Apache HTTP, Apache Tomcat, Shibboleth</td>
<td>Dott. Tobia Di Pisa</td>
</tr>
<tr>
<td>OGC Protocols and Specifications</td>
<td>Dott. Mauro Bartolomeoli</td>
</tr>
<tr>
<td>GeoServer, GeoNetwork, OpenLayers, Ext-JS, MapStore</td>
<td>Ing. Alessio Fabiani</td>
</tr>
<tr>
<td>PostGIS, Oracle</td>
<td>Ing. Daniele Romagnoli</td>
</tr>
</tbody>
</table>

DESTINATION (DangErous tranSport To New prevenTive Instruments) is a project developed in the framework of Italy/Switzerland Operational Programme for Trans-frontier Cooperation 2007-2013, in order to contribute to inter-regional road accident prevention, real-time monitoring of Dangerous Goods Transportation (DGT) and more efficient emergency management. Partnership includes Regione Piemonte as project leader, Canton Ticino, Regione Lombardia, Regione Autonoma della Valle d’Aosta and Provincia Autonoma di Bolzano. Technical partners working on the solution components are CSI-Piemonte, 5T S.r.l., Politecnico di Milano and Fondazione Lombardia per l’Ambiente. DESTINATION initiative is focused on implementation of a shared information system including environmental, territorial and technical data relevant to meet local authorities and private stakeholders needs:

- supporting decision making processes and guidelines definition related to DGT (preventive safety);
- assisting DGT companies through real-time monitoring (active safety);
- mitigating human and environmental impacts in case of accident with specific functionalities aimed to emergency assessment and management (passive safety).

Core of the solution is the preventive safety component, based on a highly detailed risk analysis model for land DGT defined by Politecnico di Milano and Fondazione Lombardia per l’Ambiente. Technical and scientific literature offers several risk formulations, typically distinguished according to the purpose of the analysis and specific objectives. Destination methodology proposes a standard and flexible solution, adaptable to different use cases (traffic planning, land planning, environmental assessment...) so to be also applicable in the passive safety field (damage assessment and emergency management). Adopted formula is based on specific parameters taking into account both accidental probability (road dangerousness; presence and type of DGT; genesis of specific DGT accident scenarios resulting from release of hazardous
substances) and damage quantification (continuous/discontinuous exposure for different types of human and environmental vulnerabilities; susceptibility of different targets for different accident scenarios; effect of risk mitigation actions in coping with accidents).

As regards active safety, the great challenge of DESTINATION initiative is raising awareness of DGT in territories involved in the project. So the central system is going to be integrated with both fixed monitoring gates, located in most critical areas able to detect the transit of DGT vehicles (capturing KEMLER and UN numbers reported in orange panels, as required by ADR regulations) and from on-board units placed on vehicles of DGT companies involved in the project (for tracing routes and type of material transported).

System functionalities, supporting execution of standard/personalized elaborations or simulations, are differentiated on the basis of user profiles. The solution is flexible enough to allow calculation of specific formula-branches and assessment of cumulate impact of multiple accident scenarios; moreover specific execution criteria (choice of geographic area, accident scenarios, human/environmental vulnerabilities...) are available for user selection, depending on chosen formula to be represented.

Main features of different elaborations available are the following:

- **Standard elaborations**, available for all users, are referred to standard temporal and weather conditions; it’s not possible for users to execute calculations changing the values or excluding/adding some of the formula parameters;
- **Custom elaborations**, for advanced users, allow change (by amplifying or mitigating) of some parameter’s values or introduction of correction factors taking into account time-dynamics (day/night rather than holiday/weekday) or weather specific conditions (rain/snow/fog);
- **Simulations**, only for specialist users, are applied to potential scenarios, as they aim to simulate possible changes in the current context. The user can edit an additional target (e.g., presence of a shopping center, or a hospital) or manually enter new values for specific parameters of the risk formula.

Elaboration results are shown both in synthetic form (thematising streets on the basis of numeric values associated to each road-stretch), and in analytic form, individuating human and environmental vulnerabilities impacted by a specific accidental scenario.

At technological level, the solution is completely open source and based on the following main components:

- the storage system consists of a PostgreSQL/PostGIS database, for vector data management, and a shared file system, for raster data management
- GeoServer provides all OGC standard geo-spatial services, including WMS, for viewing maps, WFS, for vector data extraction and editing, and WPS, for all on the fly calculation requirements and any data extraction
- GeoWebCache, acting as an accelerator for the base maps, provides map tiling and caching tile services
- GeoBatch is an Open Source Java enterprise application developed by GeoSolutions18, for the collection, processing and publication of geospatial data in real time. This component manages data ingestion from all partners, and performs format and structure harmonization. Moreover

---

18 [http://geobatch.geo-solutions.it/](http://geobatch.geo-solutions.it/)
GeoBatch automates all the pre-processing necessary for the formula calculations, so to manage them as quickly and interactively as possible

- **MapStore**, a webgis Open Source framework developed by GeoSolutions\(^\text{19}\), provides a multi-linguarm user interface (Italian, French, English and soon German), integrating and orchestrating GeoServer OGC services and metadata explorer functionalities to browse the catalogues exposed in CSW format.

In Illustration 44 the front-end of for the destination project is depicted.

\(^{19}\) [http://mapstore.geo-solutions.it/](http://mapstore.geo-solutions.it/)
NATO CMRE Super Ensemble Modeling

<table>
<thead>
<tr>
<th>Client Information</th>
<th>Timeline</th>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
</table>

The Super Ensemble Modeling infrastructure has been developed in order to allow scientists at NATO CMRE to compute the optimal mix of different models for certain MetOc geophysical parameters over a specific area of interest.

The infrastructure is composed by a few components with very specific duties:

- An Open Source tool called GeoBatch has been used to preprocess, index and publish data extract from various MetOc models.
- The GeoServer Open Source application has been used to ingest raster data upon preprocessing and to then support visualization and extraction.
- An Open Source Catalogue Server called Buddata EbRIM has been used in order to index metadata about ingested data for allowing subsequent searches.
- An Open Source workflow engine called SSE Toolbox has been used in order to orchestrate searches for MetOc data previously ingested as well as to orchestrate, on demand, the execution of the Super Ensemble Executable via extraction and preparation of the input data from the GeoServer.

---

20 [http://geobatch.geosolutions.it/](http://geobatch.geosolutions.it/)
21 [http://geoserver.geosolutions.it/](http://geoserver.geosolutions.it/)
The system was completed by a WebGIS which allowed to visualize the MetOc data ingested as well as the results of the Super Ensemble Executable. It also provided a wizard to guide the user through the creation of the input parameters to drive the Super Ensemble execution. It is worth to point out that the Super Ensemble executable was created from Matlab code provided by the scientists at CMRE via the Matlab C++ compiler in order to run it on a Linux server. Please, refer to Illustration 45 for a diagram showing the entire infrastructure and the interactions between the components.

It is eventually worth to remark on the fact that we strive to adopt whenever possible standard protocols for the interactions between the components as highlighted in Illustration 46.
Profile, Past Performance and Professional's Qualifications

Illustration 46 Super Ensemble Modeling connections between components
# NATO CMRE GEOS III Infrastructure

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATO CMRE</td>
<td>Begin</td>
</tr>
<tr>
<td>Ing. Giampaolo Cimino, <a href="mailto:cimino@cmre.nato.int">cimino@cmre.nato.int</a></td>
<td>01/06/10</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise, JMS, ESB, CAS</td>
<td>Ing. Simone Gianneccchini</td>
</tr>
<tr>
<td>Apache HTTP, Apache Tomcat, LDAP, OpenLDAP, LifeRay</td>
<td>Dott. Tobia Di Pisa</td>
</tr>
<tr>
<td>OGC Protocols and Specifications</td>
<td>Ing. Alessio Fabiani</td>
</tr>
<tr>
<td>GeoServer, OpenLayers, Ext-JS</td>
<td>Ing. Daniele Romagnoli</td>
</tr>
<tr>
<td>PostGIS</td>
<td>Dott. Lorenzo Natali</td>
</tr>
<tr>
<td></td>
<td>Dott. Damiano Giampaoli</td>
</tr>
</tbody>
</table>

As the portal states, “The NURC Geo Data Fusion Centre Geo-Spatial Web Portal is a platform for scientific data hosting. It also supports collaboration and data exchange between NURC and research partners. It hosts more than 10 years of NURC sea trials, conference pages, and Scientific Web Applications. Access to this Web Portal is password protected (except for a few public sections) and registration is required.”

The GEOS III infrastructure has been developed in order to bring coherence and automation in the task of acquiring, managing and exchanging data collected at NURC during experiments and sea trials. It is a relatively complex SOA oriented infrastructure which has been designed in order to centralized into specialized components the authentication and authorization functionalities as well as to provide single sign on capabilities between different applications in order to allow users to use the same credentials to access different applications where such application were built in a way to properly interact with the infrastructure but leaving room for legacy application using their own A&A functionalities (hence not participating into the SSO handshake).

In Illustration 47 the core components of GEOS III are depicted. We are now going to describe some of them in detail.

1. **Apache HTTPd Server**

   The Apache HTTPd Server Project is an effort to develop and maintain an open-source HTTP server for modern operating systems. The goal of this project is to provide a secure, efficient and extensible server that provides HTTP services in sync with the current HTTP standards. On GEOS-III

---

server is configured in order to perform authentication against the CAS service and authorization against LDAP

2. **ProFTP Server**

ProFTP provides FTP services for data exchange on GEOS III. Similarly to HTTP Server, ProFTP is configured in order to authenticate and authorize against LDAP. Virtual folders to NURC Experiments raw data are read/write protected against LDAP groups.

3. **CAS Server**

The CAS server implements the CAS protocol for single-sign-on services.

4. **LifeRay Portal**

LifeRay Portal is an Enterprise web platform for building business solutions. It is and will remain configured to use CAS as Authentication Security System and for providing authorization.

5. **OpenLDAP Server**

OpenLDAP is an OpenSource implementation of LDAP which, as mentioned above, manages users’ credentials as used by CAS and LifeRay portal.

6. **Front-End applications**

With this term we denote the geospatial application developed by GeoSolutions to satisfy various use cases and projects, as an instance for the management of Super-Ensemble Processes as well as Tactical Decision Aids. Usually, they consist of both a front-end and back-end component that can be deployed separately; while the back-end is usually represented by one of the other geospatial services (like the GeoServer), the front-end is rich web application based on mixes of JavaScript as well as lightweight REST services.

First of all it is worth to point out that the Core Software components are not deployed on DMZ at all. Those components usually are the ones directly connected with data or sensible information. Providing a physic separation between Applications Front-Ends and Back-Ends, external unauthorized users have no way to access raw data.

Every Application or FTP folder is moreover protected by an A&A (Authorization & Authentication) Software Level:

1. **Web Applications HTTP Access** is guarded by a CAS (Central Authentication System) Service deployed on a secured and certified SSL channel, in order to avoid malicious clients to intercept and substitute session authenticated cookies and tickets.

---


25 [http://www.jasig.org/cas](http://www.jasig.org/cas)


2. **FTP Authorization** is made against LDAP Users and Groups DataBase which is located inside the Protected Network Area.

It’s important to notice that there is no way from the outside to directly access the Users DataBase.

Moreover, once the first Authentication is successfully passed both for HTTP, through CAS, and FTP, Authorization to the specific Web Application or FTP folder is made through the “Idap” modules against the user’s LDAP Groups, which in this context represent basically a Security Granted Authority Roles.

This mechanism allows a big granularity for Security constraints and control. Users can in fact be enabled to write, read-only or disabled at all for each Web Application or part of the Application itself, or FTP folder trees or subset of them.
NATO CMRE Gliders Portal

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Information</strong></td>
<td><strong>POC</strong></td>
</tr>
<tr>
<td>NATO CMRE</td>
<td>Ing. Giampaolo Cimino,</td>
</tr>
<tr>
<td></td>
<td><a href="mailto:cimino@cmre.nato.int">cimino@cmre.nato.int</a></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise, JMS, ESB, CAS</td>
<td>• Ing. Simone Gianynecchini</td>
</tr>
<tr>
<td>• Apache HTTP, Apache Tomcat, LDAP</td>
<td>• Dott. Tobia Di Pisa</td>
</tr>
<tr>
<td>• OGC Protocols and Specifications</td>
<td>• Ing. Alessio Fabiani</td>
</tr>
<tr>
<td>• GeoServer, OpenLayers, Ext-JS, MapStore</td>
<td>• Ing. Daniele Romagnoli</td>
</tr>
<tr>
<td>• PostGIS</td>
<td>• Dott. Lorenzo Natali</td>
</tr>
</tbody>
</table>

Gliders are unmanned underwater vehicles originally designed to observe vast areas of the interior ocean. Gliders make use of their hydrodynamic shape and wings to induce horizontal motions while controlling buoyancy. Buoyancy control also allows for vertical motion in the water column. This working procedure requires low power consumption, awarding gliders with long endurance at sea (up to several months). There is a growing interest in gliders by naval forces due to their long endurance, autonomy and maneuverability at sea.

The goal of the Gliders Portal project is develop a comprehensive infrastructure for ingesting, storing, managing and disseminating all the data produced by the Gliders vehicles when deployed at sea as well as all the data useful for creating a Common Operational Picture (COP) for actually controlling them remotely (Meteorological and Oceanographic data like wind and waves forecasts, Sea Traffic maps and so on).

Ingestion and preprocessing (based on the GeoBatch28 Open Source Software) of the relevant data is performed automatically on new data arrival via a certain number of ingestion flows that have been set up which involves also a certain amount of data quality checks (developed including Octave and Matlab procedures developed by CMRE Scientists). The ingestion flows are responsible for updating the back-end (based on GeoServer and PostGIS) as well as the configuration of the User Interface (based on MapStore29) for dissemination.

---

28 [http://geobatch.geo-solutions.it/](http://geobatch.geo-solutions.it/)

29 [http://mapstore.geo-solutions.it/mapstore/](http://mapstore.geo-solutions.it/mapstore/)
In addition, the system periodically generate forecasts for the Gliders positions fusing the current Gliders positions (as acquired in near real-time from the vehicles at sea) with up-to-date meteorological and oceanographic data (mostly wind and waves).

Lastly, the User Interface has been developed so that the Gliders maneuverer can create geolocated annotations to keep track of the rationale behind specific commands sent to the vehicles.

The Gliders Portal is currently in use at NATO CMRE, it has already been used in 2 sea trials involving up to 8 vehicles at the same time sending information to the infrastructure in near real-time 24/7 for a period of time of around 1 month.
LaMMa GeoPortal

<table>
<thead>
<tr>
<th>Client</th>
<th>Technologies</th>
<th>Timeline</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consorzio LaMMa</td>
<td>• Java, JavaScript, XML, XSD, WSDL, JAXB, REST, Java Enterprise, JMS, Python</td>
<td>01/06/11 to 01/03/2013</td>
<td>Ing. Simone Gianneccchini</td>
</tr>
<tr>
<td></td>
<td>• Apache HTTP, Apache Tomcat, VMWare ESXi</td>
<td></td>
<td>Dott. Tobia Di Pisa</td>
</tr>
<tr>
<td></td>
<td>• OGC Protocols and Specifications</td>
<td></td>
<td>Ing. Alessio Fabiani</td>
</tr>
<tr>
<td></td>
<td>• GeoServer, OpenLayers, Ext-JS, MapStore, GeoNetwork</td>
<td></td>
<td>Ing. Daniele Romagnoli</td>
</tr>
<tr>
<td></td>
<td>• PostGIS, Oracle</td>
<td></td>
<td>Dott. Lorenzo Natali</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dott. Damiano Giampaoli</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dott. Emanuele Tajariol</td>
</tr>
</tbody>
</table>

The LaMMa GeoPortal was designed and implemented in order to ingest, visualize, allow searched and dissemination for the wide variety of data sources that LaMMa acquires directly or indirectly. To name a few of them:

1. MeteoSat 1st Generation Data
2. MeteoSat 2nd Generation Data
3. MeteoSat 3rd Generation Data
4. NDVI Data
5. Meteo Radar Data
6. Real Time data coming from Meteorological Stations spread over Tuscany (rain, pressure, temperature and so on)
7. Geophysical parameters coming from the ARW ECM model running twice a day at 3km and 12 km of resolution
8. Geophysical parameters coming from the GFS model running twice a day 50 km of resolution
9. Geophysical parameters coming from the MED model running twice a day 12 km of resolution

It is particularly important to remark that all this information is managed and visualized taking into account the TIME and ELEVATION dimension (e.g. sliding through the data as time changes is allowed).
Illustration 49 a screenshot of the webgis showing various sources of data overlayed on top of each other with support for the TIME dimension is shown.

Let us now briefly introduce the components used for building the infrastructure we deployed as well as the interactions between them. We will be referring to Illustration 50.

- **Ingestion & Preprocessing** data is produced or acquired at very short interval (e.g. MeteoSat data is downloaded from EUMETSAT every 15 minutes) and as such we implemented an ingestion system able to run in event-driven fashion (as soon as new data arrives). We based our development on the GeoBatch\(^30\) Open Source application inside which we created a flow of action for each type of data described above. Each flow is responsible for preprocessing, indexing and publishing for later retrieval of specific type of data. It is worth to point out that some of the actions taken during these flow have been implemented in Python or Matlab (e.g. going from raw MeteoSat data to products like Dust or AirMass) in order to allow LaMMa personnel to customize such processing further in the future.

- **Registry & Cataloguing** we have deployed and slightly customized the Open Source registry GeoNetwork\(^31\) in order to allow users to perform searches within the data ingested into the system for visualization and download purposes. It is worth to point out that the ingestion process is responsible for creating proper metadata (starting from templates that we agreed upon with LaMMa personnel) and ingesting them automatically into GeoNetwork.

- **Dissemination** we have deployed a cluster of instance of the GeoServer Open Source application in order to support visualization and dissemination through standard OGC protocols of the data acquired with support for time and elevation. As per the metadata, the ingestion flows has been configured in order to automatically ingest data into GeoServer without human intervention.

- **Front-end & Visualization** we have deployed and customized together with LaMMa personnel the MapStore\(^32\) Open Source WebGis (which is shown in Illustration 49) to act as the front-end for the end users of the infrastructure. It provides the standard capabilities of a WebGIS together with some advanced capabilities like advanced interaction with Mapping Services with time and elevation dimensions. It also provide and integrated, unique interface between search & view capabilities which allow users to perform searches for data and then load some of this data directly on the viewer itself.

It is eventually worth to point out that the entire infrastructure has been developed using Open Source components (the Operating Systems is Linux CentOS and the DBMS is PostGIS). We also tried to emphasize

\(^{30}\) [http://geobatch.geo-solutions.it/](http://geobatch.geo-solutions.it/)


\(^{32}\) [http://mapstore.geo-solutions.it/mapstore/](http://mapstore.geo-solutions.it/mapstore/)
on the possibility to evolve the system independently by LaMMA staff both in terms of processing of new data as well as in terms of customizing the front-end further.
Illustration 49 Multiple sources of data overlayed with support for TIME in the front-end
Illustration 50 High Level Overview of the LaMMA Infrastructure
The Marine Mammal Risk Mitigation project is providing naval exercise planners with information and expertise, in order to assess and mitigate risks to marine mammals from the use of naval active sonar. Support is provided at several stages, from environmental scoping for preliminary risk assessment to marine mammal monitoring tools and risk mitigation. This is achieved through a combination of data collection systems, data analysis and information management tools. With a well-established tradition in underwater acoustics, NATO CMRE has developed and tested a range of passive acoustic monitoring tools for marine mammals. These include moored systems for long term observations, deep sea gliders for cost-effective monitoring of large areas, and towed arrays for ship-based cetacean surveys. Information collected using these systems, together with oceanographic data and visual sightings of marine mammals, allows us to model their distribution, habitat preference and behavior. The Integrated Decision Aid (IDA), developed at CMRE (also known as CMRE-IDA or IDA for simplicity), combines such models with the results of a sound propagation model, mapping areas of risk to marine mammals associated with various operational scenarios.

CMRE-IDA is a web application that allows users to run and visually show on a map the Sound Propagation Models (also known as SPM). The application provides also a set of capabilities to manage both the sound propagation profiles, input parameters and generated outputs. It is also possible to execute algebra operations against the available raster layers and the SPM outputs, using the Layer Attribute functionality. The user interface is shown in Illustration 51, while
The core components of the CMRE-IDA Infrastructure are the GeoServer\(^{33}\), the Open Source project for performing ingestion, visualization, dissemination and processing of geospatial data, Octave, which is an Open Source engine to run Matlab procedures (e.g. the core models inside IDA are Matlab routines, MapStore\(^{34}\), which is an Open Source Webgis that’s been used to act as a front-end between the user and the back-end (GeoServer and Octave). In addition we use PostgreSQL with PostGIS spatial extensions as the DBMS. The infrastructure is depicted in Illustration 52. CMRE-IDA is a Service Oriented Application, composed by different modules, as depicted above. Except for the DBMS and Octave, all the modules are Java based applications, running on a Servlet/Application Container. As Java based applications they run on a Java Virtual Machine configured with default parameters during the installation procedure.

\(^{33}\) [http://www.geoserver.org](http://www.geoserver.org)

\(^{34}\) [http://mapstore.geo-solutions.it](http://mapstore.geo-solutions.it)
Profile, Past Performance and Professional's Qualifications

Illustration 52 IDA Overall Infrastructure
Consult HTS

<table>
<thead>
<tr>
<th>Client Information</th>
<th>POC</th>
<th>Timeline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConsultHTS, <a href="http://www.consulthts.com">http://www.consulthts.com</a></td>
<td>Dr. Bernhard Kamps, <a href="mailto:bkamps@consulthts.com">bkamps@consulthts.com</a></td>
<td>Begin: 01/02/13</td>
<td>End: Ongoing</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Technologies</th>
<th>Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>• JavaScript, XML, XSD, WSDL, REST, ASP, ASP.NET</td>
<td>• Ing. Simone Giannecchini</td>
</tr>
<tr>
<td>• Apache HTTP, Apache Tomcat, Microsoft IIS, VMWare ESXi</td>
<td>• Dott. Mauro Bartolomeoli</td>
</tr>
<tr>
<td>• OGC Protocols and Specifications</td>
<td></td>
</tr>
<tr>
<td>• GeoServer, OpenLayers, Ext-JS, JQuery</td>
<td></td>
</tr>
<tr>
<td>• Microsoft SQL Server</td>
<td></td>
</tr>
</tbody>
</table>

HTS is a premier innovator bringing superior, quality-focused processes and people to complex projects across North America. HTS offers the most comprehensive Transition Planning, Commissioning, and Construction Management solutions on the market, and leads the construction technology revolution with its award-winning FreightTrain software which is shown in Illustration 53.

FreightTrain is a web-based software system that is specifically designed to manage the complex activities associated with construction management, commissioning, and transition planning. Each project has its own Project Specific Website (PSW) and the forms and workflow are customized to the specifications of the individual project. Through FreightTrain’s extensive experience, we have recognized the need to develop efficient processes that ALL workgroups can agree to. The suite of FreightTrain modules has been developed and customized for the different needs of these workgroups throughout all phases of a project. FreightTrain is optimized for General Contractors, Owners, and Architects, providing:

1. Secure, Cloud-Based Data Management
2. Point of Construction Updates
3. Graphical Status Presentation
4. Full Service Project Setup
5. Customized Project Workflow
6. Time and Cost Savings
FreightTrain is a SOA infrastructure which is composed by the following components:

- **Microsoft SQL Server** is used as the DBMS solutions with spatial capabilities to ingest, manage and make accessible geospatial information about construction works.
- **GeoServer** is used as the geospatial gateway for turning informations into Map that can be consumed inside the Front-end
- **FreightTrain** itself is composed by a server side MVC Asp.NET application which interacts with the DBMS
- **OpenLayers** is being used on the client side to render maps and to perform interactions with the users like drawing elements on maps as well as managing them (move, delete, rotate etc.).

GeoSolutions staff is responsible for the proper integration of GeoServer into the infrastructure in particular:

- Proper integration of GeoServer into the data ingestion workflow
- Performance Optimization of GeoServer
- Proper integration of OpenLayers into the the presentation layer of the FreightTrain ASP.Net application (see Illustration 54)
- Development of new features related to mapping capabilities
Illustration 54 FreightTrain webmapping interface based on OpenLayers at work
University of Naples - HPC applications for Land Use Change Computation

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
<th>GeoSolutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Naples, Faculty of Agriculture</td>
<td>POC</td>
<td>Begin</td>
</tr>
<tr>
<td>Fabio Terribile, <a href="mailto:terribile@unina.it">terribile@unina.it</a></td>
<td>01/12/12</td>
<td>Ongoing</td>
</tr>
</tbody>
</table>

**Technologies**

- JavaScript, XML, XSD, WSDL, REST, Java,
- Apache HTTP, Apache Tomcat, Microsoft IIS, VMWare ESXi
- Aparapi, CUDA, OpenCL, JAI
- OGC Protocols and Specifications
- GeoServer, OpenLayers, Ext-JS, JQuery, MapStore

GeoSolutions has been collaborating with the University of Naples, Faculty of Agriculture for the development of innovative web-based solution for the computation of Land Use Change Matrices using HPC techniques. The objective is to develop an infrastructure which could be used to compute in real-time for very large areas (e.g. Country-wide or Europe-wide) the Land Use Change Matrix\(^{35}\) using HPC techniques. The work also comprised of the creation of a comprehensive front-end for the end user interaction and presentation of the results.

The first phase of the project was completed at the end of 2012 with the presentation of a simple prototype able to compute LUC Matrix at Country Level (Italy) using a Map&Reduce approach on single multicore machine. The infrastructure was based on the following components:

- **MapStore** has been used and customized to create the presentation front-end
- **GeoServer** has been used to wrap and run the process via the Web Processing Service (WPS) protocol that computes the LUC Matrix
- **Java Advanced Imaging (JAI)** has been used to implemented the high performance code for the LUC matrix computation

See [MISSING](#) for a screenshot of the first version of the tool.

The second phase of the project focuses on 2 points:

---

\(^{35}\) Land Use data is usually represented by raster data where each pixel represent a Land Use class (i.e. an integer value within a predefined map of values). Having the same data in different year (e.g. 2000 and 2006) allow us to compute a matrix that map class movements from the Year A to Year B in order to spot and understand how Land Use has changed over (e.g. green areas developed into built areas).
1. Improvements of the user interface by introducing advanced charting capabilities.
2. Evaluation and usage of GPU computing techniques for the computation of the LUC Matrix.

As far as item 2 is concerned the objective is to first select the most suitable GPU programming technique (e.g. OpenCL\(^{36}\), CUDA\(^{37}\), Aparapi\(^{38}\)) and then implement the LUC Matrix computation using such technique and integrating it into the GeoServer process for online, real-time processing. The expected speed-up should be in the order of 1 or even 2 level of magnitude (10x to 100x).

---


\(^{38}\) [https://code.google.com/p/aparapi](https://code.google.com/p/aparapi)
## DLR & EUMETSAT GeoServer Improvements

<table>
<thead>
<tr>
<th>Client</th>
<th>POC</th>
<th>Timeline</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>DLR (German Aerospace Center)</td>
<td>Torsten Heinen, <a href="mailto:torsten.heinen@dlr.de">torsten.heinen@dlr.de</a> Stephan Kiemle, <a href="mailto:Stephan.Kiemle@dlr.de">Stephan.Kiemle@dlr.de</a> Michael Schick, <a href="mailto:Michael.Schick@eumetsat.int">Michael.Schick@eumetsat.int</a></td>
<td>01/11/12 Ongoing</td>
<td>Under Testing</td>
</tr>
</tbody>
</table>

### Technologies

- JavaScript, XML, XSD, WSDL, REST, Java, Java Enterprise, Spring, JMX, JMS
- Apache HTTP, Apache Tomcat, Microsoft IIS, VMWare ESXi
- OGC Protocols and Specifications
- GeoServer, OpenLayers, Ext-JS, JQuery, MapStore, GeoBatch

### Staff

- Ing. Simone Giannecchini
- Ing. Daniele Romagnoli
- Dott. Andrea Aime
- Dott Emanuele Tajariol

The purpose of this work is to allow the ingestion, optimization, management and dissemination of multidimensional remote sensing as well as MetOc data provided by DLR and EUMETSAT in NetCDF (Network Common Data Form) format via GeoServer leveraging on the new Web Coverage Service (WCS) 2.0 specification with support for the Earth Observation (EO) profile for accessing raw un-portrayed data as well as on the Web Map Service (WMS) for disseminating maps portrayed out of the raw data by specifying proper rendering instructions.

In Illustration 58 we have depicted all the components we have leverage on as well as the interactions between them and the functionalities they provide. The Ingestion & Preprocessing functionalities needed in order to prepare incoming data for ingestion in GeoServer are provided by GeoBatch, which is responsible for sensing specified directories looking for the arrival of data files in order to preprocess them as needed.

[39](http://www.unidata.ucar.edu/software/netcdf/)

[40] See [http://geobatch.geo-solutions.it](http://geobatch.geo-solutions.it)
and then publish them in GeoServer via the geoserver-manager library. As far as this preprocessing is concerned it is worth to point out that GeoBatch is mainly responsible for:

1. inspecting the received data in order to make sure it is properly formatted
2. perform a polynomial rectification with nearest neighbor interpolation on the non georectified data preserving the initial spatial resolution, format and products layout
3. perform eventual (optional) optimizations like creation of external overviews for better performances

Three flows will be created for managing the ingestion and optimization of the various type of data we were provided with:

- GOME2 ingestion flow
- ASCAT Ingestion flow
- POLYPHEMUS Ingestion flow

GeoServer has been customized in order to, on a side, support the new WCS protocols and application profiles and, on the other side, to both provide better support for the ingestion and dissemination of multidimensional raster data (especially in NetCDF format) as well as (although this is an optional part of this proposal) Postgis 2.0 raster data sources.

In order to allow GeoServer to ingest, manage and disseminate multidimensional raster data as required some work has been performed at the GeoTools level as well as the GeoServer level. GeoServer supports a relatively large number of raster formats as inputs (take also into account GDAL based formats), however there is no direct support for NetCDF files. The usual way to support multidimensional raster data (i.e. raster data that exposes, at least, TIME and ELEVATION as dimensions) is by leveraging on the flexibility of the ImageMosaic plugin.

The ImageMosaic plugin is raster store (which therefore lives at the GeoTools level) that supports stitching of similar raster data over multiple dimensions, not only spatial. Similar means:

1. Same pixel layout (number of bands, data type, color model)
2. Same CRS (no reprojection is made)

---

41 GeoServer can only serve raster data that is georectified, hence ASCAT data needs to be rectified prior to being published in GeoServer

42 GeoServer is based on the GeoTools Open Source library-

43 We usually use the word dimension with the same meaning of the word SampleDimension from the OGC WMS specification to indicate additional independent dimensions that can be used when querying a dataset, like time, elevation, wavelength and so on.
3. Same Spatial Resolution (although granules at different resolutions are accepted by *ignoring* the presence of eventual internal overviews)

The Plugin uses an internal index to catalogue the granule it needs to work on; such index contains for each granule information like, the physical location as an URL, the bounding box, as well as additional information as required that can be seen as attributes useful to distinguish a granules from another. These attributes are automatically turned into the standard TIME and ELEVATION sample dimensions as per the OGC WMS specifications, however additional dimensions are supported to capture custom dimension not foreseen by the OGC specification but which may be important in specific use cases (e.g. RUN_TIME for MetOc data).

This mechanism of indexing is very powerful as it allows us to ingest data in near real-time and have the dimension of a single raster layer in GeoServer grow overtime without increasing the number of layers served. It is however worth to point out that currently we have one hard limit, each single granule must point to a single 2D file (with bands if needed) having different row in the index point to different portion of a multidimensional file is currently unsupported. The rationale behind this design decision is that usually multidimensional data comes in very specific formats (even when based on standard containers like NetCDF, HDF or GriB) hence in order to minimize the impact of differences between the various formats, avoid performance problems with very large multidimensional files containing a large number of geophysical parameters, as well as to isolate them as far as possible from the GeoServer we have always performed a split of the multidimensional files into 2D slices with proper metadata for the dimensions supported (e.g. time and elevation) and we then ingested and mosaicked them as such.

This limitation/assumption has been overcome and reworked to meet the goal of limiting format conversions and file duplications to a minimum (essentially for storage space limitations) by enabling the ImageMosaic indexing mechanism to work nicely even when the granules to be served does not come from a single independent 2D Slice represented by a single file on disk but also when the granules’ index contains single entries that points to portion of a complex multidimensional file; we are now able to extract on the fly 2D slices from multidimensional NetCDF files. As an instance it is possible to serve directly Polyphemus data out of the original NetCDF files without any splitting but by allowing the ImageMosaic to read 2D slices out of NetCDF files.

It is also worth to clarify once again how we cope with data arriving in near real-time while keeping the Capabilities document for WCS and WMS as compact as possible. We already mentioned the work did for allowing the ImageMosaic plugin to serve directly NetCDF files, however we did only briefly mention that can use the ImageMosaic to create stores that would ingest new data over time without creating new layers but simply growing specific dimensions:
Illustration 55 Indexing a single multidimensional NetCDF file

1. for MetOc data, like Polyphemus, we can have 3 dimensions, TIME to capture the forecast times, ELEVATION, to capture elevations values for the parameters and RUNTIME (or reference_time) that would be an additional time dimension that would capture the reference time or runtime of each single model run to be ingested.44

2. For EO data we can capture new acquisition using a TIME parameter bound to the acquisition time, so that new acquisitions for a certain geophysical parameter will simply add new values to this TIME dimension without creating new layers.

In Illustration 57 this approach is depicted.

It is eventually worth to point out that GeoSolutions has pushed all the changes to the various Open Source components into their respective code repositories in order to ensure that the investment made by the client was sustainable in the future.

44 As mentioned before we do assume that this reference time will be acquired from either the file name or from its internal metadata.
Illustration 56: Indexing a single NetCDF file

Illustration 57: A single multidimensional mosaic for multiple multidimensional NetCDF files

For each single 2D slice contained in the multidimensional NetCDF file we have an entry to index it for successive stitching.
Illustration 58 Overall proposed infrastructure
LiberoLogico – CUSTOM Project, Cloud Computing & Application Store for Tourism & Culture

<table>
<thead>
<tr>
<th>Client</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information</td>
<td>POC</td>
</tr>
<tr>
<td>LiberoLogico S.R.L.</td>
<td>Dr Paolo Lanari, <a href="mailto:paolo.lanari@gmail.com">paolo.lanari@gmail.com</a></td>
</tr>
</tbody>
</table>

**Technologies**

- JavaScript, XML, XSD, WSDL, REST, Java, Java Enterprise, Spring, JMX, JMS
- Apache HTTP, Apache Tomcat, Microsoft IIS, VMWare ESXi
- OGC Protocols and Specifications
- GeoServer, OpenLayers, Ext-JS, JQuery, MapStore, GeoBatch

**Staff**

- Ing. Simone Gianneckchini
- Dott Alessio Fabiani
- Dott Tobia di Pisa
- Dott Lorenzo Natali

The CUSTOM Project is an R&D project funded by the Region of Tuscany in 2010 whose goal was the creation of a Cloud-based Cultural Heritage & Tourism Store for the management of value added applications, that is, put simply, a cloud infrastructure able to host third-party applications for providing services related (but not limited to) tourism and cultural heritage.

The infrastructure aims to take care of the Cloud Service Levels up to IAAS and PAAS providing clients with a comprehensive environment to deploy and manage the entire lifecycle applications. An online store for selling new instances of the available software following the SAAS model was also implemented and tested (it was based on the Magento Open Source Product) using applications provided (and adapted) by the

45 http://www.customstore.it/index.php?lang=it
46 http://en.wikipedia.org/wiki/Cloud_computing#Service_models
47 http://www.magentocommerce.com
partners of the projects (called Building Blocks); the outcome of the project has been an infrastructure able to exploit existing hardware resource and providing an API to deploy legacy applications to a Cloud infrastructure for the provisioning of SAAS services. It is worth to point out that most of the infrastructure was built using Open Source Products.

The Geographic Building Block was implemented by GeoSolutions using its own Open Source Product with the goal of allowing users to ingest, manage and disseminate geospatial data and maps according to international as well as de-facto standards. In Illustration 60 the Building Block is depicted and will now be briefly described. GeoSolutions has worked closely with the infrastructure team to adapt is components for working in a cloud environment including the ability to tear up and down dynamically new instances of the applications.

GeoSolutions has leveraged on and deeply customized the following components for building the Geographic Building Block:

- The Open Source Product GeoServer has been used to provide the functionalities for ingesting, managing and disseminating geospatial data, raster and vector, according to Open Geospatial Consortium (OGC) and ISO Technical Committee 211 (ISO TC 211) standards. Specifically GeoSolutions has extended GeoServer to create an Enterprise version called GeoServer Enterprise\(^{48}\) which includes a few additional Enterprise functionalities like Back-up and Restore if its configuration as well as advanced clustering.

- The Open Source Product MapStore\(^ {49}\) has been entirely developed within this project in order to providing client-side mapping services. MapStore is an Open Source webgis framework highly modular developed to create, manage and share securely in a simple and intuitive way maps and mashups created mixing contents served from servers like Google Maps, OpenStreetMap, Bing or from server adhering to OGC standards like WMS, WMTS and TMS. MapStore is composed by various components not all of which are mandatory and as such are optional can be removed and/or customized in ways that can be used to simplified smaller deployments as well as their management. Let us know briefly describe such components introducing their key features.

- The Open Source Product GeoFence has also been developed in order to provide advanced A&A services for GeoServer. It is an external web application that allows administrator to define fine grained access policies for data served by GeoServer using either a user interface or a REST API.

In addition to the aforementioned products, GeoSolutions has developed the connections (via the so called Agents) with the underlying infrastructure in order to allow this component to work smoothly in it; this

---

\(^{48}\) [http://geoserver.geosolutions.it/](http://geoserver.geosolutions.it/)

\(^{49}\) [http://mapstore.geosolutions.it/](http://mapstore.geosolutions.it/)
includes the possibility to hot deploy new instances of the applications as well as to backup and later on restore their configuration.
Illustration 60 The Geographic Building Block
### NATO CMRE OpenData Portal

<table>
<thead>
<tr>
<th>Information</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>NATO Centre for Martime Research and Experimentation (CMRE)</td>
<td></td>
</tr>
<tr>
<td>POC</td>
<td>Status</td>
</tr>
<tr>
<td>Alessandro Berni, <a href="mailto:Alessandro.Berni@cmre.nato.int">Alessandro.Berni@cmre.nato.int</a></td>
<td>01/09/13 – 31/12/13, Ongoing</td>
</tr>
</tbody>
</table>

#### Technologies

- JavaScript, XML, XSD, WSDL, REST, Java, Java Enterprise, JMX, JMS
- Apache HTTP, Apache Tomcat, VMWare ESXi
- OGC Protocols and Specifications
- GeoServer, OpenLayers, Ext-JS, JQuery, MapStore, GeoNetwork, CKAN

#### Staff

- Ing. Simone Gianneckchini
- Ing. Emanuele Tajariol
- Dott. Ing. Tobia di Pisa

NATO CMRE has been acquiring a tremendous amount of highly valuable environmental data throughout the years during its sea trials. Most of this data is already available for download via the GEOS3 system using HTTP and FTP links on a per sea trial basis, however a comprehensive search & download portal which would allow authorised users to discover content by performing searching and predefined metadata at global level is missing; users need to more or less be familiar with the directory structure of CMRE sea trials website to be able to download the data they might be looking for. In addition no or little information about provenance, quality and similar information is available prior to download.

The goal of this project is to lay down a plan for:

- creating proper metadata following international as well as NATO standards described the resources acquired during an entire sea trial
- deploying an IT infrastructure able to ingest, index and perform searches on the created metadata, both via a user-friendly graphical user interface (GUI) as well as via standard protocols for machine-to-machine interaction
- maintaining and growing over time the base of described data via the above mentioned metadata with the long term objective to put online in a human-friendly searchable manner information about the whole catalog of data available on CMRE GEOS3 system
Particular care is being taken for protecting the information that will be put together for feeding the system. At a minimum only authorised users via login will be allowed to perform queries on the system. Existing access policy will still be enforced as far as access to real data will be attempted.

The architecture offers distinct endpoints for different external access types (see Illustration 62):

- Metadata queries via OGC CSW protocol will be handled by GeoNetwork directly
- Metadata search and presentation via a user interface will be handled by CKAN
- Access to data files will be performed by Apache HTTPd directly

As part of this project we intend to deploy an instance of GeoNetwork 2.10 in order to ingest, manage and disseminate (both directly via CSW as well as indirectly via CKAN UI) metadata about the data collected during CMRE sea trials. It is worth to point out that we do not intend at this stage to expose the GUI of GeoNetwork to end-users as we will force them to perform visual searches via the CKAN GUI (see Illustration 61). In terms of metadata standards we intend to customize GeoNetwork to support the NATO Geospatial Metadata Profile (NGMP) which is a specialization of the ISO19139 metadata standard adopted by NATO. In order to allow direct download via HTTP of the data being described with metadata files, that latter will contain proper elements (e.g. OnlineResource elements) indicating the links on GEOS3 to where such data is available. Standard CMRE access policy enforcements will kick in once such links will be followed upon (see Illustration 63).

CKAN 2.2 will be deployed in order to act as the Open Data portal for allowing users to perform visual searches to discover the data they are looking for. CKAN will be customized in order to allow it to harvest metadata from GeoNetwork via the CSW protocol periodically. Proper metadata will be indexed for later search and transformed once ingested in order to allow a nicer presentation to users without redundant information (we are talking about complex XML files). Download links will be extracted from the original metadata files and presented to the users in a comprehensive manner via the GUI of CKAN (see Illustration 63).

Existing fine grain access policies will be enforced once users will follow the download links to the existing sea trials pages. Only authenticated users will get access to the system in order to perform searches via the User Interface or via the CSW protocols. An authenticated user will be able to search for any metadata in the system as we do not foresee a closer integration with CMRE authentication and authorization system at this stage. Forcing an authorization filter on metadata according to the groups the user belongs to is not part of the work we are proposing but could be accomplished by customizing GeoNetwork and CKAN.
Welcome to CMRE OpenData

The CMRE GeoData Fusion Centre GeoSpatial Web Portal is a platform for scientific data sharing, it also supports collaboration and data exchange between CMRE and research partners. It hosts more than 16 years of CMRE seawards, conference papers, geo-referenced Web applications, access to the SMR which is a user-friendly, open-source data access tool for non-specialist users and research is required.

How to register

Click on the link on the top right of the page to register as user account. A list of Contact of CMRE should be specified in the request form. For new user requests (e.g., access to new systems) please send an email to geo-references@cmre.cnr.it, specifying the permission. Further inquiry functionality is available for the free user.

How it works

Once logged into the user can browse applications, visit links and conferences from the main content on the left. The user will only get access to sections (e.g., publications) above for new user request. For access to all the CMRE GeoData Fusion Centre GeoSpatial Web Portal data it is required to register.

Illustration 61 CMRE OpenData Portal CKAN User Interface

Illustration 62 CMRE OpenData Portal CKAN Architecture
Illustration 63 CMRE OpenData Portal CKAN Resource Details
OpenDataNetwork Project

<table>
<thead>
<tr>
<th>Client Information</th>
<th>POC</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>• County of Florence</td>
<td>Chiara Lorenzini</td>
<td>01/12/12 - 30/09/13</td>
</tr>
<tr>
<td>• County of Prato</td>
<td>Lorenzo Cipriani</td>
<td></td>
</tr>
<tr>
<td>• City of Prato</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Arno River Authority</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="mailto:chiara.lorenzini@provincia.fi.it">chiara.lorenzini@provincia.fi.it</a></td>
<td></td>
</tr>
<tr>
<td></td>
<td><a href="mailto:lcipriani@provincia.prato.it">lcipriani@provincia.prato.it</a></td>
<td></td>
</tr>
</tbody>
</table>

The Open Data Network Project it’s a joint project promoted by a few Public Administration located in the Italian Region of Tuscany, namely:

- County of Florence
- County of Prato
- County of Pistoia
- Arno River Basin Authority

which have decided to create a federated infrastructure for the publication of their data (geospatial as well as alphanumeric) as OpenData. The project has been also partially funded by the Region of Tuscany.

The Project has draws its essence from the experience accumulated during the C.E.R.C.O. project which aimed at creating a federated Spatial Data Infrastructure (SDI) for the dissemination of geospatial data as
Open Data for a number of Public Administrations in the region of Tuscany. The goals and aims have been so far expanded to provide a single entry point for the dissemination and exploitation of Open Data both geospatial and alphanumeric.

GeoSolutions has provided technical support for the implementation and deploy of the infrastructure as well as for the training of the partners for the management and evolutions of the platform in use. The current version of the system can be found at the link below:

http://www.opendatanetwork.it/

In terms of infrastructure and components, the overall infrastructure is depicted in Illustration 64 while the architecture for each single node is provided in Illustration 65. The goal of the federation is to allow each partner to deploy the components he would need to have a complete and ready-to-use infrastructure for the publication of data as Open Data relying on Open Source products and accounting for the possibility to reuse existing components (e.g. proprietary geospatial servers) in order to minimize the impact. The Central Hub would then harvest the information from each Partner’s Deployment (with particular care on avoiding cyclic graph in the harvesting set up) in order to act as the single entry point for the entire network. The possibility to have multiple hierarchical level is foreseen and actually possible to implement with no further development (e.g. a new County could join acting also as an Hub for its own cities which would not be harvested by the Central Hub).
The Node Architecture puts together all the building blocks that a Partner could need to ingest and disseminate geospatial and alphanumeric data with particular emphasis on geospatial data. We also tried to use as much as possible existing standards for the interconnections in order to account for the possibility to swap some components with other similar ones. E.g. it would be possible to swap the catalog implementation from GeoNetwork to a different catalog providing it implemented the OGC CSW protocol (see Illustration 65).

Illustration 65 Open Data Network Single Node Architecture

Going into more details, let us briefly list the various components as well as their role. Let us also stress again that all the components provided are free and Open Source.

- **Postgresql+PostGIS**, is an enterprise level RDBMS with extensive and powerful support for geospatial data both raster and vector.
GeoNetwork is an Open Source geospatial catalogue that implements many standards both in terms of metadata as well as in terms of protocols.

GeoServer + GeoWebCache is an Open Source geospatial server that can be used to ingest, manage, and disseminate geospatial data and metadata via international as well as de-facto standards like OGC WMS, WFS, WCS, GeoRSS, GeoJSON, and so on.

Tolomeo is an Open Source JavaScript framework based on OpenLayers and Ext-JS that can be used to access OGC Services like WMS and WFS.

CKAN is the de-facto standard when it comes to Open Data portals. It is free and Open Source and is in use in many large-scale high-end government portals. It provides default tools to enable geospatial searches, harvest multiple sources, comprehend other CKAN instances, and it is easily customizable in terms of GUI appearance as well as data source support.

In Illustration 66 the user interface of the hub currently in use is depicted. It can be reached at this link.

http://geonetwork-opensource.org/
http://tolomeogis.comune.prato.it/
http://ckan.org/
http://www.opendatanetwork.it/