

Integrating Regional Geoportals within a Web Content Management System Framework

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1. Abstract

SERVIR is an international collaboration sponsored by NASA and USAID to provide solutions for environmental monitoring and decision support in developing regions around the world, using satellite remote sensing and other geospatial data. SERVIR acquires and integrates data sets from a variety of heterogeneous sources, performs or facilitates their analysis, and provides decision-makers with a user-friendly, synthesized view of their region to help them deal with important issues affecting their people and the environment. One of the key challenges is helping the target user communities effectively find and make use of a growing volume and variety of data, information, and services.

This paper highlights the efforts of developers at the SERVIR Regional Nodes in East Africa and Mesoamerica to leverage the customization capabilities of the ArcGIS Geoportal Extension (version 9.3.1) to achieve “one-stop” consolidation of spatial data resources with web content managed by a .NET Web CMS framework.

2. Introduction

Geographic information is a valuable resource for applications and analyses services where the location of objects and themes, including the study of the direct relationship on interrelated phenomena, can enhance policy and decision making activities at all levels within organizations in both the private and public sector. Over the last 20 years, the growing availability of all kinds of data from many different sources has helped GIS technology become more useful and widely adopted; consequently, as haystacks of information grow larger and needles ever smaller, the search for critical information is becoming increasingly difficult. The challenge for organizations is not actually the lack of

information but is the overwhelming volume of information and the technical solutions, data organization and management policy that have been put in place in order to effectively manage this data.

This problem is not solved by simply using a standard search engine on the internet but rather a system that can accommodate many different types of data and present it in a uniform format through metadata that provides content description, quality, geographic type and spatial information about a dataset.

With the internet infrastructure for global data access now being fully functional, geospatial technologies have similarly evolved and dramatically converged with a variety of formal information and communication technology disciplines. Of particular importance are web portals which are online catalogs that enable the posting, discovery and exchange of information resources which include web services that enable the interoperability of geographic data. The core capabilities provided by the web portal have since been extended to specifically support geographic services giving rise to the terminology geospatial information portal which specializes in the posting, discovery and exchange of map-based geographic information (*Creating and Maintaining a GIS Portal*, ESRI 2008). The Geoportal is generally put in place as one of the technical elements in the implementation of a comprehensive spatial data infrastructure.

The basic process of metadata publishing and geospatial resource discovery enabled by the Geoportal is illustrated below:

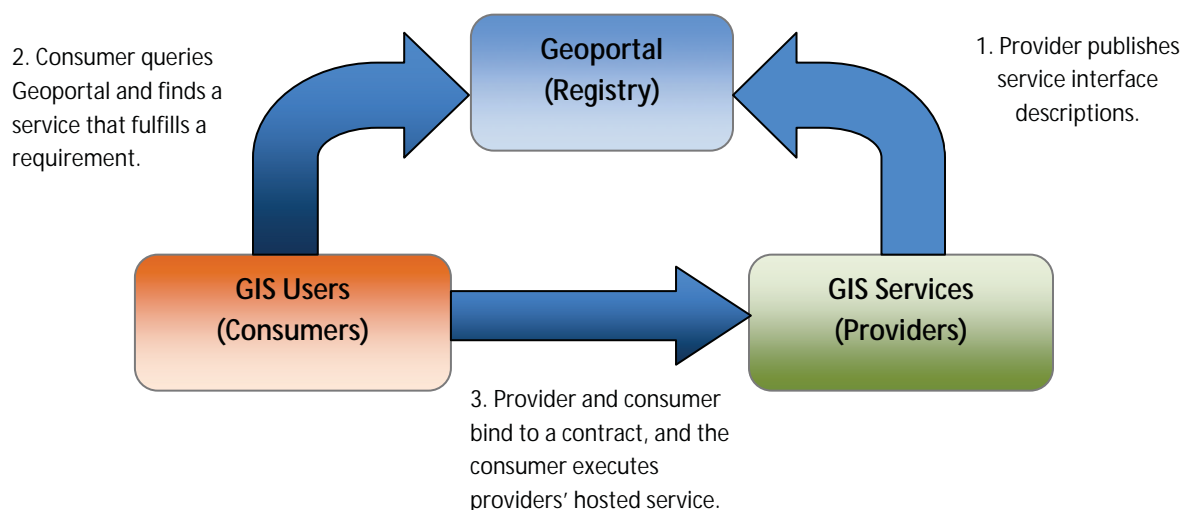


Figure 1: Illustration of the Publish-Find-Bind pattern as implemented in a Geoportal.

The core method of communication within the Geoportal is based on a Service-Oriented Architecture (SOA) which provides a bridge between “separate islands of data and

processing services” where geospatial content and services remain with the responsible authority – government agencies and private sector organizations. The authoritative source for geospatial content and services becomes the Geoportal as the channel to disparate and distributed content and services.

Publishing a capability or offering a service is referred to as “export” (publish). Finding a service request against published offers or discovering services is referred to as “import” (Find). Binding a client to a discovered service is referred to as “service interaction” (Bind).

This paper therefore discusses the implementation and customization of ESRI’s Geoportal software – ArcGIS Server Geoportal Extension version 9.3.1 - in the context of realizing a fully-fledged service oriented architecture and web-based geoprocessing capabilities integrated with DotNetNuke - a web content management system (CMS) based on Microsoft’s DotNetNuke technology – thereby making it possible for data producers to publish information about data and users can locate the appropriate datasets that they need including through advanced searches based on a single or multiple collection of particular metadata fields. Brief overviews of the two application frameworks are discussed below.

2.1 ArcGIS Server Geoportal Extension

The ArcGIS Server Geoportal extension is a platform that enables the cataloguing of spatially referenced resources through a centrally managed metadata repository. It provides a web-based environment for managing resources that reference spatial databases, cartographic products, Open Geospatial Consortium (OGC) and ArcGIS web services and related metadata from a variety of sources thereby enhancing the spatial information exchange and sharing between organizations using the capabilities of the internet.

The Geoportal extension enables authoring of metadata documents using a variety of metadata profiles including FGDC, ISO 19139 and it can further be customized to support additional metadata profiles as needed.

In addition to performing geospatial resource search and discovery using the front end interface of the Geoportal extension, it is possible to use the REST and OGC Catalog Service for the Web (CSW) interfaces to discover resources registered with the GeoPortal from client applications such as RSS Readers, web content management systems or custom desktop applications.

2.2 DotNetNuke

DotNetNuke is an open source web CMS for building web sites based on Microsoft .NET technology.

The system provides the generic capabilities of a content management system such as multilingual support, document management, scalability and extensibility, and therefore the benefits of integrating geospatial search and discovery capabilities in a web CMS framework are very significant in the context of developing a one stop web portal for discovering, visualizing and using geographic data including its related non-spatial resources.

3. Methodology

The products and services made available through the Servir platform are based on user-driven needs and demands which implicitly are embedded during in the design of component system applications. One of the core components is the resource search and discovery component for both geospatial and non-spatial resources. As is the norm with standard computer systems, it is paramount that the search module properly meets the user's needs and satisfies their expectations.

3.1 Requirements Specifications

The initial set of requirements identified by the Servir technical team for the first release of the web portal were:

- i. Enable basic search whereby a search input box on every page will allow the user to perform a quick search based on key words.
- ii. By default, the basic search will examine content the content from the title and abstract sections of the metadata documents which have been approved in the Geoportal.
- iii. Capability to control what parameters the search will be applied to (e.g. content type, Servir 'themes' such as Biodiversity, Climate, and Ecosystems). These will be configured at specific sections or pages within the web CMS. Servir themes apply only to content from Servir data sources where the special list of Servir themes has been applied.
- iv. Default parameters that should be returned in the search results are: title, abstract, metadata unique identifier, date modified, content type and thumbnail URL. These properties will be configured at the Geoportal level.

- v. Provide sort capabilities of the search results based on date modified, title and content type.
- vi. Provide a mechanism to apply a 'Select by Attributes filter' to the search results after the initial search is made. For example, combinations of Servir themes, content type and date modified.
- vii. Advanced Search – Provides an input form for users to indicate a variety of specialized search options such as range of modifications date, content types, data themes, area of interest.

3.2 Requirements Analysis

The benchmark that was set out for the solution that was to be subsequently used to provide the Geoportal search integration into the DNN framework was:

- The service should conform to open standards and hence, should be programming language or platform independent.
- The service should be fully customizable to enable specification of returnable properties such as title or content type, define specific metadata fields that the request query should search against, and should provide greater flexibility in specifying the comparison operators to be applied for each metadata field.

Generally, the Geoportal extension provides two open standard search interfaces, that is: the REST API and the OGC Catalog Service for the Web (CSW) version 2.0.2 interface specification.

The REST interface provides a mechanism through which users can specify, for example, the content type to search for, data category, bounding box and even the output format of the results which can either be GeoRSS, KML, HTML and JSON; the search parameters and corresponding values are specified in the query string of the URL that points to the Geoportal's REST interface.

In addition, the Geoportal extension supports the implementation of the OGC CSW 2.0.2 interface which in essence employs HTTP POST and SOAP implementations for request/response handling to the Geoportal's catalog service. When a metadata record is published, the Geoportal is able to extract searchable properties and represent it in a uniform structure regardless of any specific metadata schema and hence it becomes possible to retrieve indexed metadata properties from a CSW search regardless of the type of the metadata document. The operations supported by the CSW interface include: GetCapabilities (of the service), DescribeRecord, GetRecords, GetRecordsById, GetDomain, Harvest and Transactions support.

Consequently based on Servir's Geoportal search specifications, the CSW interface provides the best solution for integrating Geoportal's search capabilities into a DNN instance, which was chosen as the ideal platform based on its capabilities to provide a framework for developing enterprise spatial solutions based on Servir's current technical and human resource capabilities.

3.3 Component Design

Based on the integration module specifications, a middle-tier component that sends and receives requests/responses to the catalogue service on behalf of DNN is required. This component consists of two assemblies which are purely responsible for sending requests and parsing responses respectively. These interfaces are widely implemented in various modules within Servir's web portal where geospatial resources need to be retrieved from the Geoportal. These are:

3.3.1 CSW Request API

This assembly provides methods to build and valid absolute CSW requests that will subsequently be sent to the remote Geoportal catalog service for processing. The design is shown below:

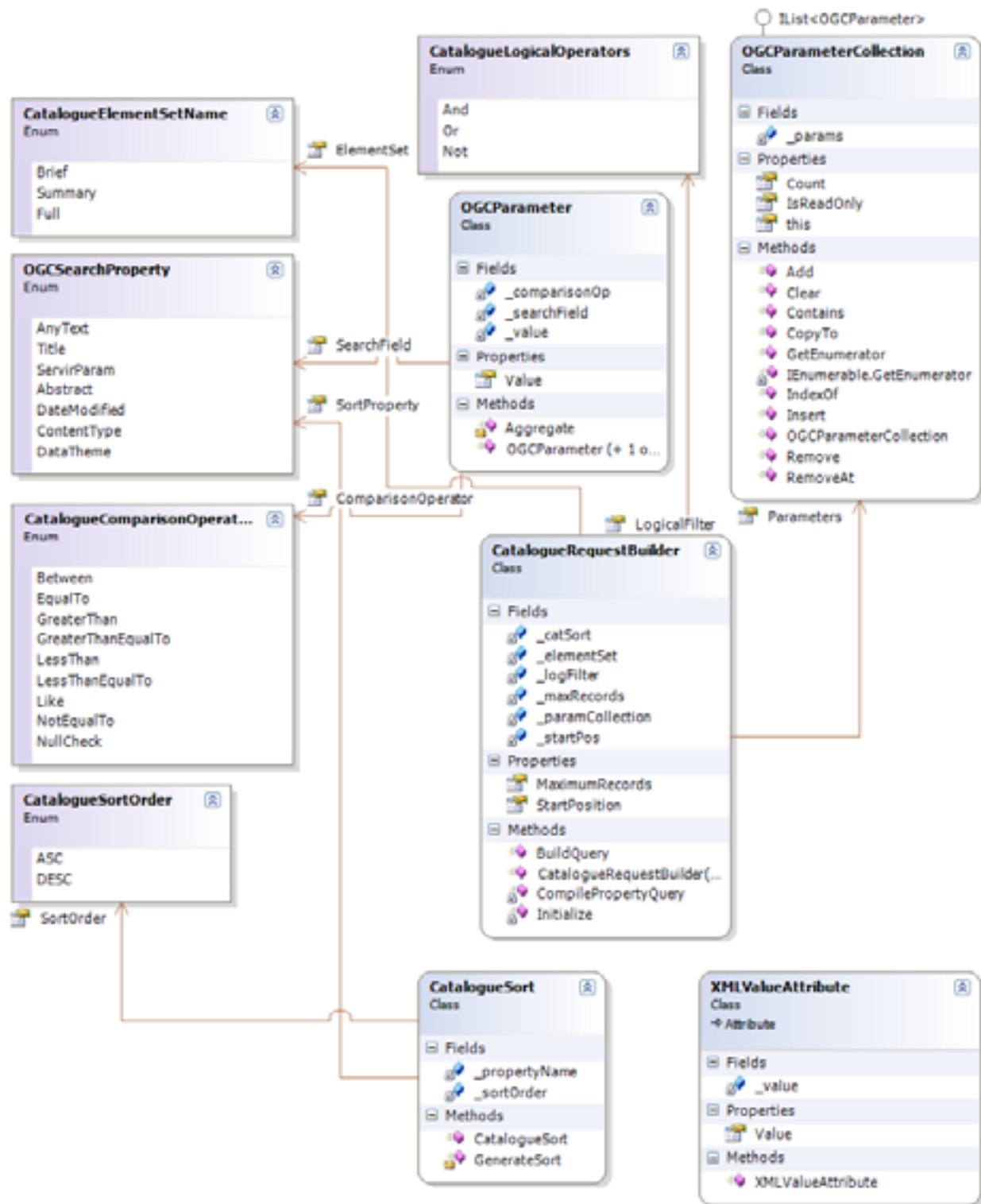


Figure 2: CSW Request Builder Class Diagram

3.3.2 CSW Response Handler

DotNetNuke uses the Provider Model in its architecture in order to allow core functionality to be replaced without modifying the core code. This is in addition to the Singleton Pattern which is used to ensure only one (self) instance of a class is instantiated. Thus, the *GeoportalCSWDataProvider* class in the CSWResponse assembly follows these two best-practice design patterns. The design is illustrated below:

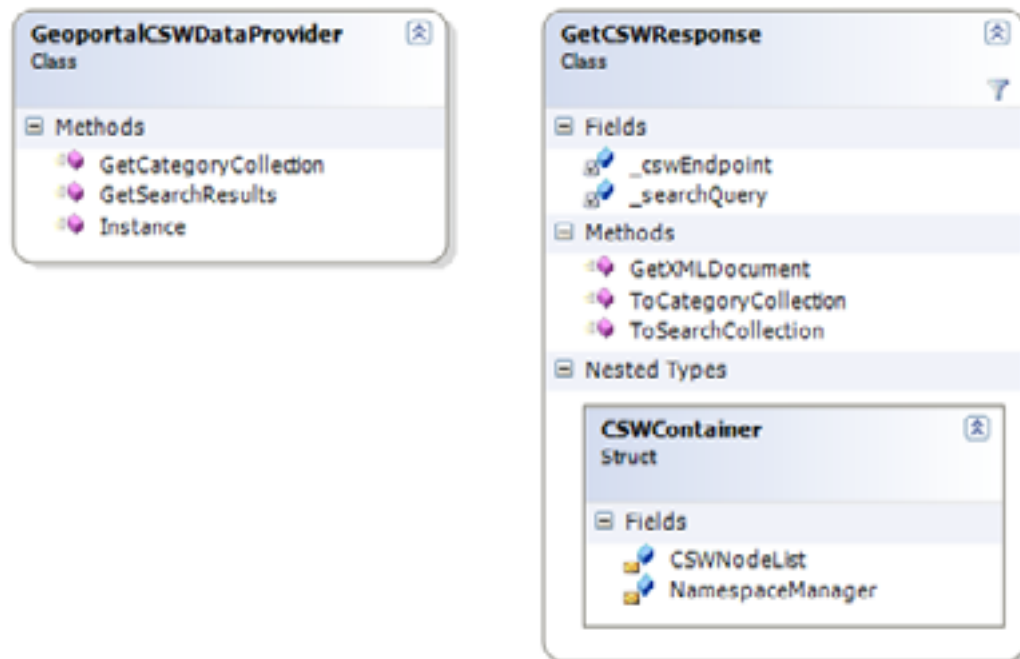


Figure 3: CSW Request Handler Class Diagram

3.4 Geoportal Skinning

There are multiple modules within the web portal that provide an interface to the Geoportal for detailed metadata views, hence it is important that when users select to view the details of a geospatial resource that is presented in the Web portal, they are redirected to a Geoportal page that looks identical to the Web portal.

4. Results

By comparing the consistency of the result sets from the Geoportal module in Servir's web portal and those directly from the Geoportal interface, it vital to point out that the two fully match and ideally this should be the case since both interfaces communicate to the same catalog service though using different clients. The main search interface in the

web portal implements basic search criteria by querying looking for matching patterns in the title and abstract fields of metadata records (see *Figure 3 below*),

Register | Login

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Search Results Thursday, May 20, 2010

Search Results

Search results for **kenya rivers**

Kenya Rivers - Relevance: 0

1 Rivers covering the entire country. They were captured from SRTM 90M Digital Elevation Model.
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 4/29/2010 2:47:35 AM

Kenya - Rivers (Africover) - Relevance: 0

2 The source of Kenya - Rivers (Africover) is FAO-Africover. The rivers have been produced from...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 12/3/2009 7:15:35 AM

RIVERS DIGITIZED FROM TOPOGRAPHIC MAPS OF KENYA - Relevance: 0

3 These are shape files (vector) of Rivers digitized from topographic map of Kenya at scales 1:50,0...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 11/11/2009 1:38:55 AM

Nairobi rivers - Relevance: 0

4 Nairobi rivers dataset was digitized from the urban plan map of Nairobi at a scale of 1:10,000, u...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 12/9/2009 7:18:18 AM

Tanzania - Rivers (Africover) - Relevance: 0

5 The source of Tanzania - Rivers (Africover) is FAO-Africover. The rivers have been produced from ...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 12/3/2009 4:40:25 AM

Sudan - Rivers (Africover) - Relevance: 0

6 The sources of Sudan - Rivers (Africover) is FAO-Africover. The rivers have been produced from ...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 12/1/2009 3:51:01 AM

Bor Town Rivers in Southern Sudan - Relevance: 0

7 Bor Town Rivers in Southern Sudan dataset shows hydrological features within Bor town. These are ...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 11/27/2009 4:38:36 AM

Wau Town rivers in Southern Sudan - Relevance: 0

8 Wau Town rivers in Southern Sudan dataset shows water resources within Wau town, Western Bahr el-...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 11/27/2009 8:32:54 AM

Juba Town rivers in Southern Sudan - Relevance: 0

9 Juba Town rivers in Southern Sudan dataset shows water resources distribution in Juba town, Bahr ...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 11/27/2009 6:11:22 AM

RIVERS DIGITIZED FROM TOPOGRAPHIC MAPS OF SOMALIA - Relevance: 0

10 These are shape files (vector) of Rivers digitized from topographic map of Kenya at scales 100,00...
<http://servir.com/geoportal/catalog/search/viewMetadataDetails.page> - 11/11/2009 11:59:47 PM

Figure 4: Search results of Geoportal items in the Web portal instance. The metadata records are parsed to a format that is compatible to the web portal search results setup.

By clicking on either the title or resource link for each search results item, the system redirects to the Geoportal's metadata details page which has been reskinned to give the same overall look and feel, and the same primary navigation structure. Hence, users can navigate to/from the different systems without this being apparent (see *figure 4 below*).

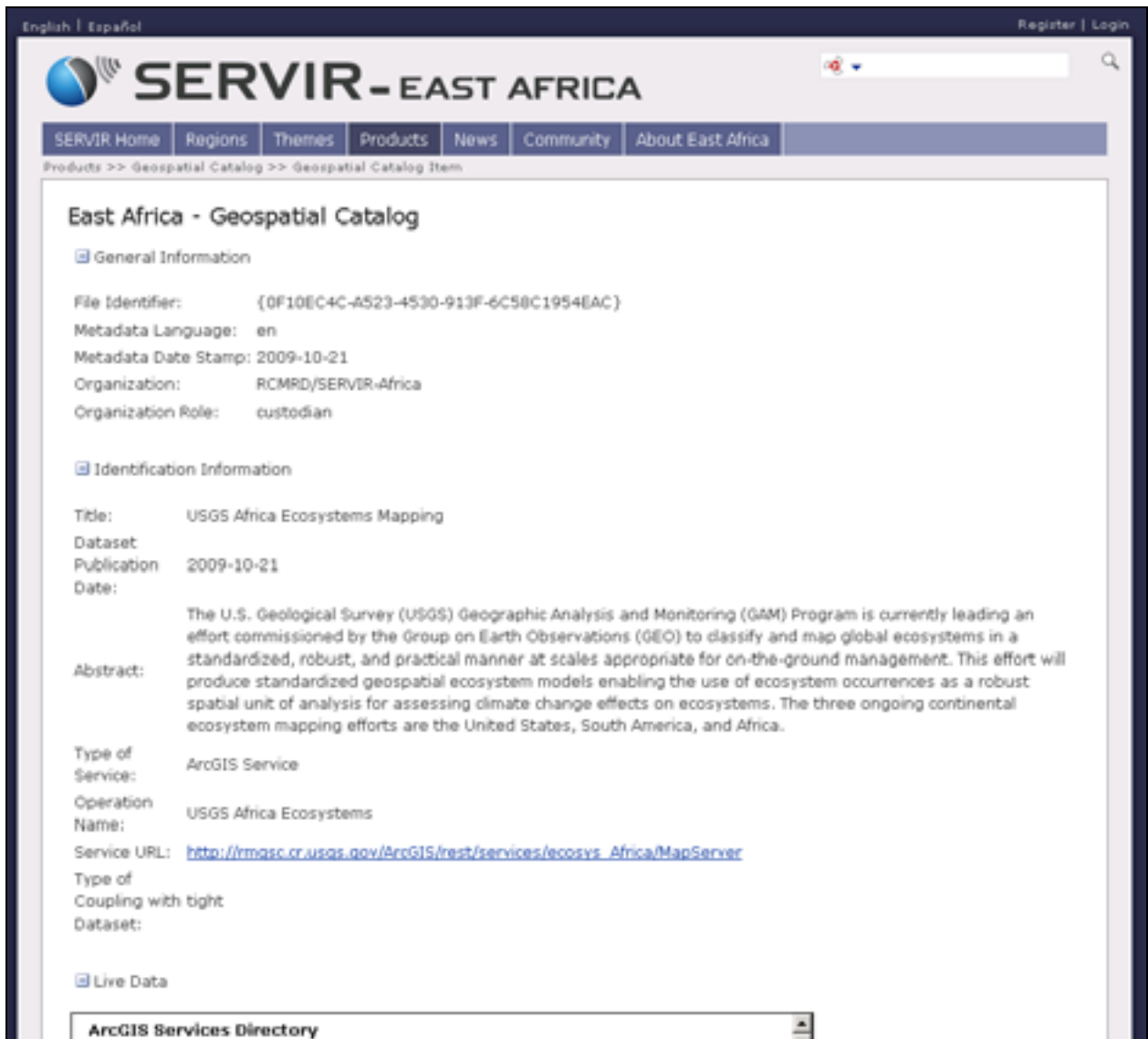


Figure 5: Details metadata page in the Geoportal system. It has the same look and feel as the Web portal.

Additionally, the customization capabilities of the Geoportal extension have enabled Servir to extend the standard metadata profiles (FGDC, ISO 19115 and ISO 19139) with an additional theme section which enables the tagging of datasets currently held at the regional centers (in Nairobi and Panama) with GEOSS-derived themes such as climate, disasters, agriculture. These custom themes have been indexed meaning that they are discoverable through a standard CSW interface.

The Servir web portal has dedicated sections in the respective regional sub-portals that provide detailed information on these specific themes which include a direct link to resources in the Geoportal that have been tagged with the custom themes; this provides users with express access to geospatial resources while they are navigating in a specific

theme section within a given regional sub portal. This capability is provided a custom category module that lists Geoportal items sorted by date for a particular theme.

5. Discussion

Based on the capabilities of the CSW interface, Servir will be looking to provide most, if not all, of these capabilities through the web portal front end. These will include not only attribute searches, but also spatial searches of geospatial resources through custom mashups, direct publishing and validation of geospatial resources, and providing high-performance geovisualization services in the quest of making Servir a truly Geospatial one-stop service.

The overall goal of the Servir Geospatial One-Stop is to increase the access to and use of spatial information through the utilization of interoperable web services, GIS middleware and shareable geographic knowledge. Expanding this access and usage is important in the region especially now that institutions handling spatial data are working towards building spatial data infrastructures at national level and Servir will play an important role in spatial services development. The development of the products focuses on usability for both power and casual users with the guiding principles of accuracy, interoperability and speed.

Currently, the time when geospatial data and applications can be shared across the web is not yet with us but with the active role played by Standard organizations such as the OGC and software vendors that are now beginning to build and support these standards and structures that may make this feasible in the near future.

6. References

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