

Increasing Interoperability and Reducing Geospatial Application Development Effort at NBII

By

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Abstract:

NBII works through a distributed network of NBII nodes and NBII partners. Since the technical skills and funding vary across this limited interoperability network, NBII has focused on the development of services and toolkits under NBII's SOA based Geospatial Interoperability Framework. These toolkits and services improve interoperability, significantly reduce geospatial application development effort, and help integrating legacy non-geospatial databases and existing ArcIMS based applications. NBII services such as the Catalog service, the Gazetteer service, and the bounding box service, can be used by any application without the overhead of hosting and maintaining the data and the code. The NBII network is currently serving around 452 map services with approximately 30,000 data layers. These layers can be discovered through Catalog service and consumed in any ArcIMS, portal or web application. NBII toolkits can be plugged into any ArcIMS, portal or web application for consuming NBII services or extending legacy geospatial applications.

Introduction:

The USGS - National Biological Information Infrastructure (NBII) <<http://www.nbii.gov>> is a broad, collaborative program to provide increased access to data and information on the nation's biological resources. The NBII links diverse, high-quality biological databases, information products, and analytical tools maintained by NBII partners and other contributors in government agencies, academic institutions, non-government organizations, and private industry. NBII partners and collaborators also work on new standards, tools, and technologies that make it easier to find, integrate, and apply biological resources information. Resource managers, scientists, educators, and the general public use the NBII to answer a wide range of questions related to the management, use, or conservation of this nation's biological resources.

This paper covers how NBII implemented a Service Oriented Architecture (SOA) based Geospatial Interoperability Framework for increasing interoperability among NBII nodes & partners and reducing Geospatial application development time.

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The Need:

NBII, NBII nodes, and NBII partners (all three will be referred as NBII in this paper) have made accessible a significant amount of biological data with plans on increasing the amount of data online in future years. These resources, mostly mapping applications and databases can be consumed by any Internet accessible application through an XML interface. However, there was no mechanism in place for discovering these web-services in the context of geography or place, and subsequently analyzing the discovered data and services. NBII needed a mechanism in place for its users to search for these valuable resources by geography.

NBII, NBII nodes and partners work on developing software applications for addressing specific biological concerns or issues and making biological data available to the public and scientists over internet. Development of such applications requires time, expertise and resources which vary across the nodes and partners. Users of these applications did not have flexibility of mapping or analyzing the application data with other data or services of their interest, limiting users to the analysis of data provided by the application.

NBII identified their needs as:

- a) Limited expertise, resources and funding at NBII nodes and partners
- b) Non availability of data over internet or in a standard form for analysis
- c) Limited interoperability of Geospatial applications
- d) Limited interoperability of data
- e) Non-integration of Geospatial applications with NBII portal

Proposed Solution:

For addressing above needs NBII defined 'Geospatial Interoperability Framework' (GIF):

- a. Define a standard based framework to carry out all development and data publishing
- b. Make research data available through standard based web-services for e.g. web-map services (WMS), web feature services (WFS), web coverage services (WCS), and catalog services for web (WCS) etc.
- c. Define HTTP and XML based web-services for providing common functionality.
- d. Define web service remote portlets (WSRP) for making NBII geospatial applications and portal interoperable.
- e. Defining toolkits (pluggable software components) for making existing applications interoperable with NBII GIF.
- f. Defining toolkits for consuming NBII GIF services.

The Challenges:

Implementing proposed solution was not an easy task due several factors: the legacy of the existing applications, the limited expertise and availability of staff within the

distributed NBII network, and the complex nature of implementing new concept of interoperability across the huge NBII network.

Serving data over internet was not an easy task due to the fact that it required addressing security issues, publishing into NBII catalog, creation of metadata, and continuous maintenance.

While NBII has resources and expertise for maintaining existing Geospatial applications (ArcIMS, portal and web), often these resources are not devoted full time to these tasks. Therefore, adding a small feature to an existing application competes with other priorities for work within the organizations. Given that modifying existing applications to allow for e.g. a catalog search and consuming searched content was evaluated as a difficult task, it seemed unlikely that the nodes would be able to accomplish the task in a reasonable timeframe.

Additionally, NBII did not have an interoperability framework in place for re-using data produced by partners or nodes.

Then, to complicate the situation a bit more, a solution for a single application might not be portable to other applications. Given the limited resources within the NBII Nodes, would there be resources within each node to make modifications or future enhancements when standard specifications advance?

The Solution:

NBII adopted the strategy of using standard based specifications like ebXML, WSDL, SOAP, and OGC specifications for publishing, discovering and consuming of maps, data and services. NBII needs a solution which was easy to maintain, extend and deploy and which could be integrated with existing NBII environment like portal, legacy databases and applications.

Keeping above points and challenges in mind, the solution was divided into following components.

- g. Defined a standard based framework to carry out all development and data publishing
- h. Made research data available through standard based web-services for e.g. web-map services (WMS), web feature services (WFS), web coverage services (WCS), and catalog services for web (WCS) etc.
- i. Defined HTTP and XML based web-services for providing common functionality like Gazetteer digital place name lookup, catalog lookup etc
- j. Defined web service remote portlets (WSRP) for making NBII geospatial applications and portal interoperable.
- k. Defined toolkits (pluggable software components) for making existing applications interoperable with NBII GIF and reducing software application development time from months to few days.

1. Defined toolkits for consuming NBII GIF services. These client toolkits helped in adding more functionality to existing or new applications. For e.g. client toolkit for NBII catalog server.

Following image describes system architecture of non-plumtree portal NBII GIF environment.

GIF System Architecture

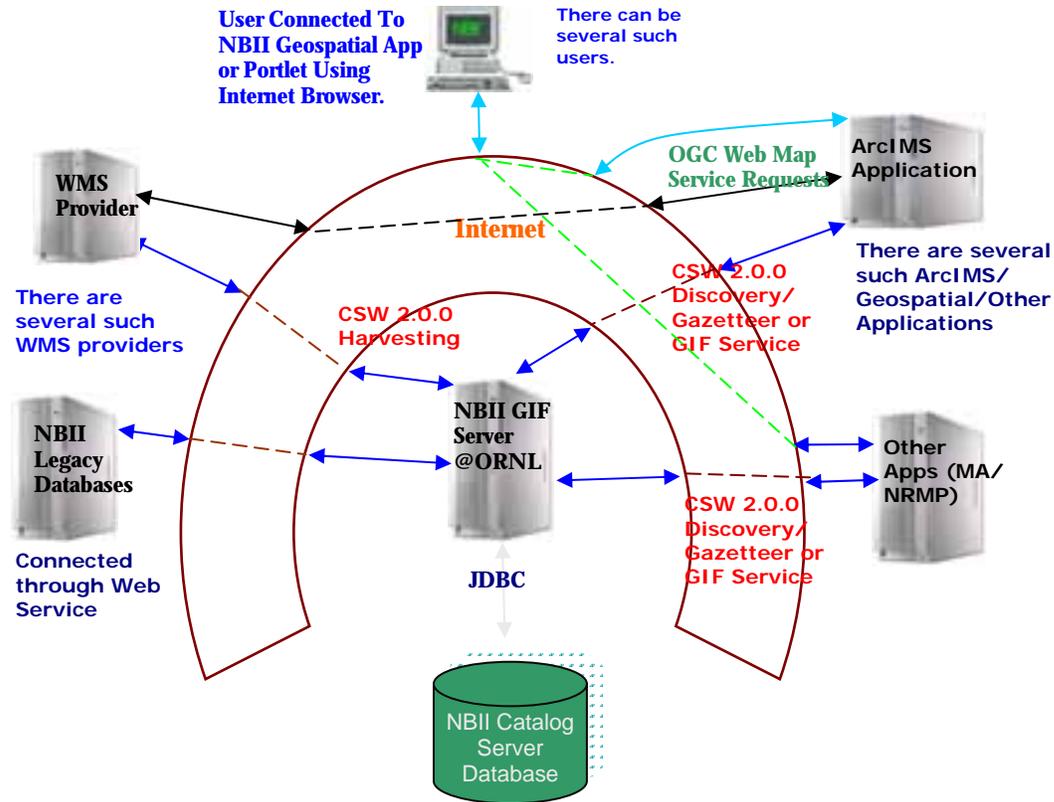


Figure 1 – GIF System Architecture

Following image describes overview of 'System Architecture' of the NBII portal environment in the context of NBII GIF.

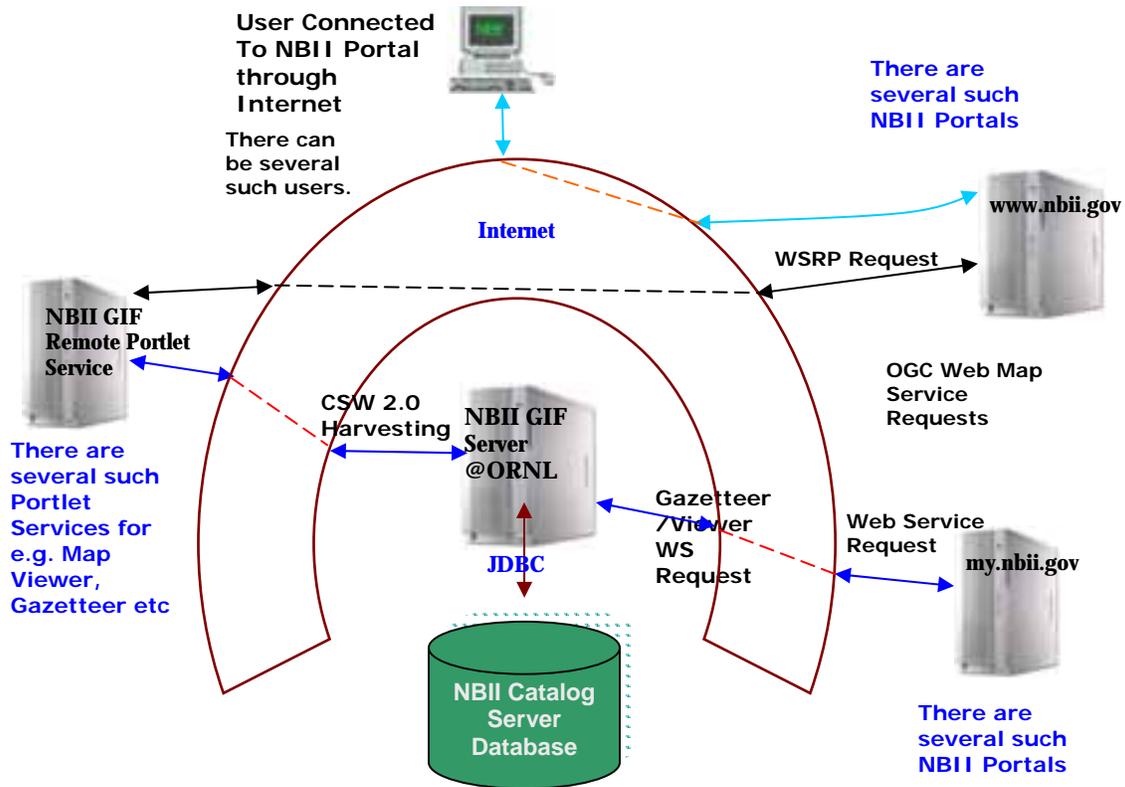
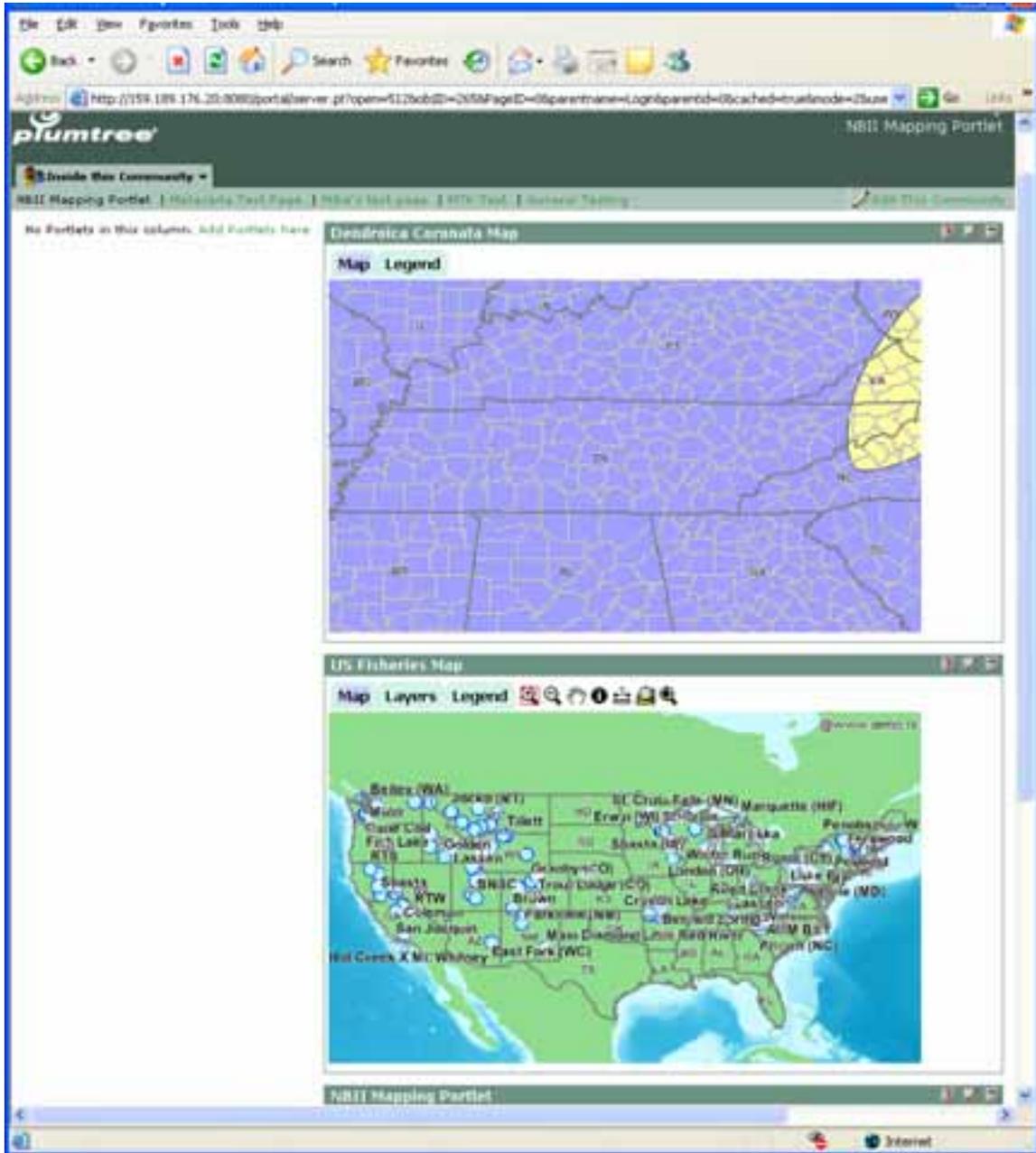


Figure 2 – GIF System Architecture for Portals

Following image is of NBII's portal using NBII GIF mapping portlet service. One portlet service is configured in two different portlets working as two different applications. Same portlet service can be configured to work as several different mapping applications meeting the needs of all NBII nodes and partners.



Advantages of GIF toolkits and services:

Streamlined development and maintenance:

- reduction in time for portlet development at NBII portal..
- reduction in time for maintaining and growing these portlets.
- enhanced productivity during general application development,
- reduction in time for maintaining and growing these applications,
- reduced time for supporting new standard based specifications for e.g. OGC, ebXML, USGS-GNIS gazetteer etc,
- helped reduce duplication of effort in using and maintenance existing data such as the National Map.

Enriched the end-user experience:

- increases discovery and availability of data by allowing re-usability of Internet accessible data,
- increases data currency within portlet or geospatial applications by using up-to-date data directly from the data producer, and
- Allows the users of the NBII applications or NBII portlets to analyze and use data in ways not anticipated by the developers.

Sites, Using NBII GIF toolkits and services:

Following sites have been developed using the NBII GIF toolkits and services:

- <http://hoosier.cr.usgs.gov/services/mps/index.htm?displayers=2> This map viewer can be integrated to any web-site using IFRAME tag and can query NBII catalog server.
- <http://hoosier.cr.usgs.gov/services/mps/portlet.jsp> This service can be used for making a WSRP (web service remote portlet).
- <http://wdc.nbii.gov/ma> This site belongs to Millennium Ecosystem project and using NBII GIF Map viewer.
- <http://wildlifedisease.nbii.gov/mass3> - This site is using 'Extended HTML Viewer' Toolkit for existing sites. This site also uses Gazetteer service for zoom-in to a place. This site has been developed by Wild Life Disease Node of NBII.
- <http://wildlifedisease.nbii.gov/epizoo2> - This site is using 'Extended HTML Viewer' Toolkit for new sites. This site also uses Gazetteer service for zoom-in to a place. This site has been developed by Wild Life Disease Node of NBII.
- <http://128.173.240.47/MainNodeOGC/> - This site is using 'Extended HTML Viewer' Toolkit for existing sites. This site has been developed by Virginia Tech (MAIN node of NBII).
- <http://hoosier.cr.usgs.gov/NBIIOGCNewAppTemplate/> - This site is using 'Extended HTML Viewer' Toolkit for new sites.

NBII GIF Information Sites:

Following sites provide useful information about NBII GIF:

- <http://nbii-catalog.ornl.gov> This is main NBII GIF portal providing various Geospatial services for e.g. Map Viewer, Catalog Service, Gazetteer Service etc.
- <http://geospatial.nbii.gov> This portal provides important information about NBII GIF. All toolkits and information about various NBII services can be found on this portal.

Conclusion:

NBII GIF toolkits and services (WSRP, WS, HTTP based, and OGC services etc) have reduced development time of any portlet or application from a minimum of two months to just a few days. These toolkits and services help to integrate provided functionalities into an existing application or portlet within few hours of time. NBII is saving on an average of two months of labor per application development for each reuse of service or toolkit. Additionally, since these toolkits and services use common components, maintenance of these components has been reduced across all users.

Additionally, the NBII portlets or Geospatial applications are becoming richer, allowing a better user experience. Users can now find and use data that is available on the Internet and registered in an NBII catalog.

NBII GIF has made most of its published data interoperable and reusable through NBII GIF toolkits and services. Users can easily find the data and integrate it either statically or dynamically in any application using GIF client toolkits.

BIBLIOGRAPHY AND REFERENCES FOR ADDITIONAL INFORMATION

NBII Geospatial Interoperability Framework Functional Requirements (2005-04-19), National Biological Information Infrastructure (NBII). Available [online]. < <http://geospatial.nbii.gov>>

NBII Geospatial General Design (2005-07-11) , National Biological Information Infrastructure (NBII). Available [online]. < <http://geospatial.nbii.gov>>

FGDC-STD-001-1988, Content Standard for Digital Geospatial Metadata (version 2), US Federal Geographic Data Committee, <<http://www.fgdc.org/metadata/contstan.html>>

OGC 01-068r3, Web Map Service Implementation Version 1.1.1 Specification

OGC 02-006, OGC Abstract Specification Topic 12: OpenGIS Service Architecture

OGC 02-017r1, WMS Part 2: XML for Requests using HTTP POST Version 0.0.3 Discussion Paper

OGC 02-023r4, OpenGIS Geography Markup Language (GML) Implementation Specification, Version 3.0 (29 January 2003). Available [online]: <<http://www.opengis.org/docs/02-023r4.pdf>>.

OGC 02-058, Web Feature Service Version 1.0.0 Implementation Specification

OGC 02-070, Styled Layer Descriptor Version 1.0.0 Implementation Specification

OGC 02-076r3, Gazetteer Service Profile of Web Feature Service Version 0.0.9 Discussion Paper

OGC 03-025, Web Services Architecture Version 0.3 Discussion Paper

OGC 03-026, Service Information Model Version 0.3 Discussion Paper

OGC 03-036r2, Web Context Documents Implementation Specification RFC

OGC 03-040, OGC Reference Model Version 0.1.2

OGC 03-065r6, Web Coverage Service Version 1.0 Implementation Specification

XML 1.0 (October 2000), Extensible Markup Language (XML) 1.0 (2nd edition), World Wide Web Consortium Recommendation, Bray, T., Paoli, J., Sperberg-McQueen, C.M., and Maler, E., eds., <http://www.w3.org/TR/2000/REC-xml>

WSRP, Web Service Remote Portlet Specifications

BEA Aqualogic/Plum Tree portal WSRP specifications