



NBII GEOSPATIAL INTEROPERABILITY FRAMEWORK

GENERAL DESIGN

July 11, 2005



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NBII GEOSPATIAL INTEROPERABILITY FRAMEWORK

GENERAL DESIGN

INTRODUCTION

This document is the follow-on and companion to the one entitled [Geospatial Interoperability Framework: Functional Requirements Description](#), which laid out requirements for components, standards, and practices of an evolving framework to leverage geospatial information effectively within NBII. The present document proposes general design for elements of the GIF. In particular, it describes components and applications to be implemented in three phases. These phases might best be understood in terms of the increasingly sophisticated applications and the features and services that they enable.

Phase 1 – Discover and visualize map data

Phase 2 – Collaboratively publish geospatial content

Phase 3 – Create, analyze, and model geospatial information online

The design of the GIF is also expressed within each phase through a number of standard viewpoints used to describe distributed systems. It starts with the “Enterprise” viewpoint largely presented in the Functional Requirements Document, and continues in this document with the design of components and services. The purpose of this approach is twofold. First, each of these aspects is essential to a successful and durable distributed application system. Second, we endeavor here to layout as much as possible of the GIF Design independently of particular choices for implementation technology. Those choices are recommended within this design document as well, but the consequences for re-design of changing technology choices is (we hope) minimized.

The first section of this document consists of an overview of a number of the technical design elements, which make up the design “toolkit” for each subsequent phase. This also serves as a gradual transition from the requirements descriptions of the previous document to the design descriptions of this one.

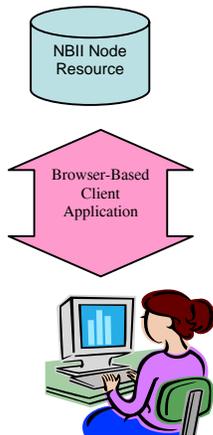
OVERVIEW

This section lays out several critical design and specification principles, which will characterize the GIF throughout its development and deployment.

SERVICE-ORIENTED ARCHITECTURE

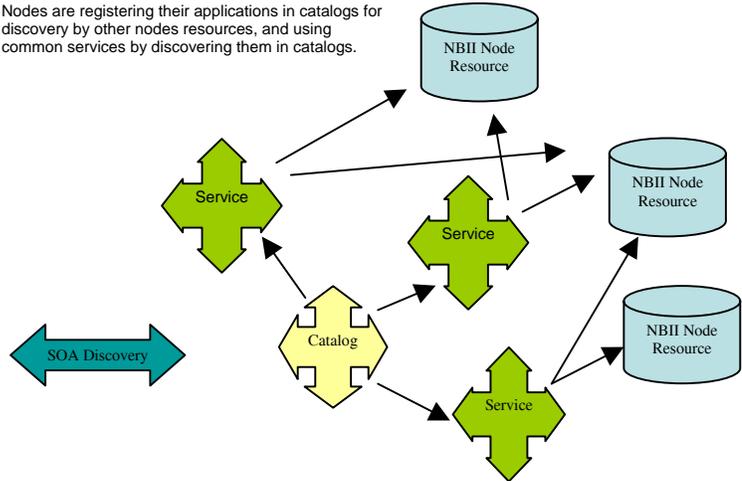
Today

Nodes are developing specific applications with no common service or components, and no accessibility to other node resources



Future

Nodes are registering their applications in catalogs for discovery by other nodes resources, and using common services by discovering them in catalogs.



A distributed application can be organized in many different ways, from a rigid client-server connection to fluid peer-to-peer networks. Given technology able to implement any of these designs, the one which best matches the enterprise for which it is intended is preferable. While client-server designs may be appropriate for a strongly centralized organization and peer-to-peer networks best for fluid, ad hoc communities, the service-oriented architecture (SOA) is usually the most effective middle way. In an SOA, there are many distributed components, but most components play defined roles as either importers or exporters of functionality and content. Hovering over both is a catalog role, which enables the user of a distributed application to find the necessary components with which to accomplish his or her task.

The SOA is clearly seen as enabling separation of functionality into different computing tiers, with client and server roles, but also allowing those tiers to be assembled “as needed” from diverse sources thanks to the operational metadata provided by catalog components. The “guided” flexibility offered by SOA is clearly a design which most closely models the actual organization and functioning of NBII.

CATALOGS (~REGISTRIES)

The critical component distinguishing a service-oriented architecture from a client-server architecture is the registry – catalog component. This component maintains and exposes metadata about services and resources across the network. While the term “catalog” tends to invoke the idea of endless descriptions of content to be searched and pored over, the trader component has a very specific function of bringing together the diverse parties in an SOA, whether they are resources,



services, clients, or users. This includes a variety of information, which enables users to find content, clients to find services, and users to find the contributions of other users. An important design capability of an SOA catalog is being able to manage those metadata record types needed to make the system (e.g. GIF) function, not just one or two predetermined formats.

Another notion implied by catalogs is that some mysterious back end process maintains catalog contents. Because the catalog role is so critical, in an effective SOA there need to be more formal, distributed, and automated methodologies for catalog maintenance.

DATA SERVICES

Among the various types of services or “providers of content”, data services are the “wholesale” components among categories defined in ISO 19119 (Geographic Information Services). Such servers as Web Feature Servers generally provide the most direct and fundamental SOA-enabled connection to data resources. The provided data formats are likely to require processing in a client application to be of much utility to a user, however.

There is much confusion over the difference between a data service and a database. A client-server developer will value the power and flexibility of having her application access an Relational Database Management System (RDBMS) directly through a SQL interface. This makes sense within the tightly managed hierarchy of a Client-Server application; however, RDBMSs are not by and large designed to function as independent components with catalog-usable metadata, limited interfaces, and compatibility with common SOA protocols (e.g. http, xml) required of a data service. An RDBMS, especially a spatially-enabled one, is certainly a good idea as the engine behind a data service, but exposing the raw SQL interface of such an engine as a directly Internet-accessible component is almost never a good idea.

The essential implementation-hiding nature of a service (= operations + content + processing semantics¹) implies that a data service can take any approach needed to document and serve up its data. Like a bank, it is not required to have every byte ready at hand; indeed, services such as geocoders will generally return requested address data records by generating them on the fly. On the other hand, producing side effects with a data service can be a slippery slope, when parameters, which are formally defined as query parameters, are actually being redefined as inputs to a computational or other process. In the case of a geocoder, there may not be a clear means of (re-) defining the general data service interface, to make clear to a client for example that a longitude coordinate may be requested for a set of address parameters, but address records cannot be requested for a range of longitude coordinates.

¹ A formal term for “meaning”: what a client understands that a service will return in response to a service request



MAP SERVICES

The most common GIF components will be portrayals of map services. Such services as Web Map Servers are intended to present geospatial and other data in a form (map images) as easy as possible for (human) users to utilize. Discovery and description of maps requires, therefore, an additional level of metadata, which covers issues of style, scale, representation, format, etc. and connects them back to the data used to generate the portrayal.

Portrayal services begin strongly to overlap with the possible functional roles of client components, since a client application may either request and display a map image, or request data directly and portray that data locally. While the client and server roles are shown singly in the SOA architecture, there is no essential limit to the number of components which might be chained together to perform a task or which steps in bringing resources to users are covered in which component. What matters is that each connection between components is clearly defined to have a “client end” and a “server end”, and that the trader / catalog in the picture can provide guidance to the resulting network topology.

A map server may in fact function as a client to data services and a service to map clients; this “service composition” may be managed on the fly within the SOA, or it may be hidden completely behind the map service interface, depending on the enterprise context and trade-offs such as performance versus distribution flexibility.

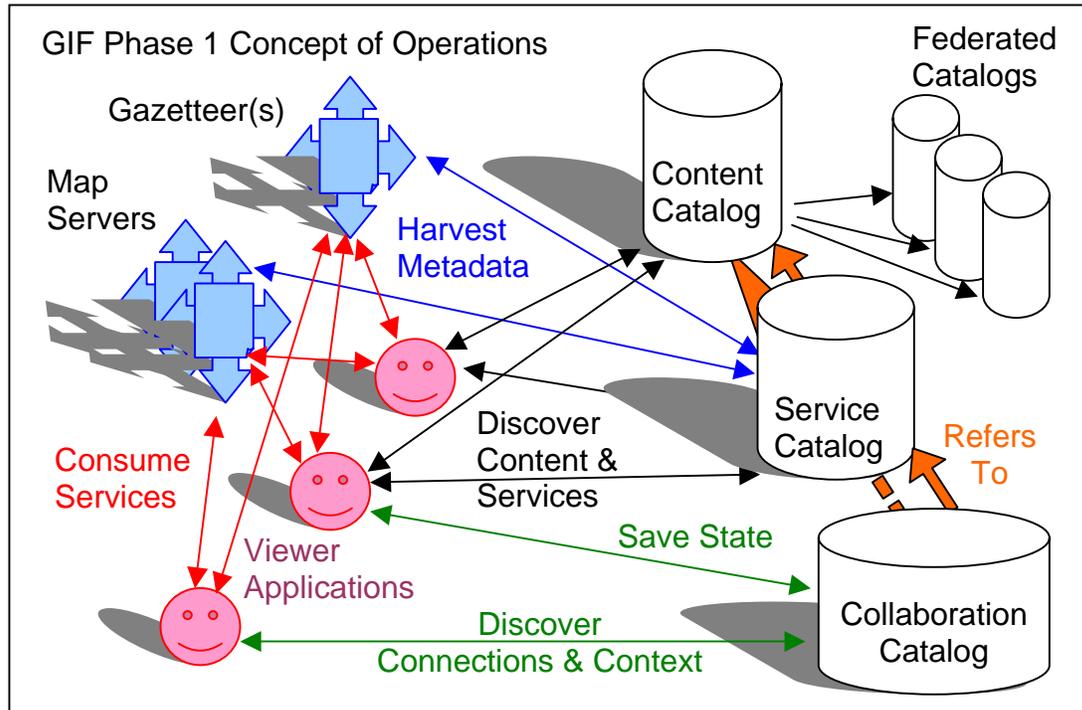
OTHER SERVICES

There are other services that are within NBII and are not exclusively used within the GIF such as the NBII Search Engine, NBII Biocomplexity Thesaurus, NBII Collaboration services, and the UDDI Catalog or Registry for core Web Services. These components are considered within the overall GIF and are included in the Design for integration purposes.

COMPONENTS

Loosely defined, a component can be described as a compilation of services chained together with business process logic to meet a specific functional requirement. Two types of components will be described in this design document: Geospatial components that are created to support the core functionality of the Geospatial Interoperability Framework for all NBII Nodes and partners, and NBII Enterprise Architecture components are those created to support specific node level functional requirements.

GENERAL FRAMEWORK DESIGN



FRAMEWORK COMPONENTS AND SERVICES

The following section describes the anticipated components in a fully operational GIF, and loosely defines the services that will be needed within each component. The development of these components will happen within one of three Stages in which the GIF will be rolled out.

For this document, Geospatial components are those that are directly related to the geospatial discovery and use of geospatial resources within the NBII. The NBII Enterprise components listed are necessary within NBII but are not exclusive to the GIF, and will need to be integrated into the overall framework. These components are considered within the overall GIF and are included in the design for integration purposes. These NBII Enterprise components will not be developed within the GIF.

GEOSPATIAL COMPONENTS

The Geospatial Components to be included in the GIF are listed below in the appropriate modules, and further described in the next section of this document.



CATALOG SERVICE MODULE

This component contains the catalog of geospatial service offerings of the NBII and associated services necessary to enable the entities within this catalog to be discovered, accessed, and linked. This includes the following services:

Services to be included: Catalog Web Service, (including Web Map Services, Web Feature Services, and Web Coverage Services)

GEOREFERENCING MODULE

This component contains the services necessary to georeference content, service (and data) catalog entities, as well as provide services for the location based searching and retrieval of those entities by human and machine interfaces. These services are described and discovered within the Service Catalog, and used by the mapping module, content catalog module, and content linking module as functionally required.

Services to be included: Geocoders, Gazetteers, and Geoparsers

GEOPROCESSING MODULE

This component contains services common to most geospatial applications that can be performed by a server and used in a distributed environment. These services are described and discovered within the Service Catalog, and used by the mapping module, content catalog module, and content linking module as functionally required.

Services to be included: Buffering, Coordinate Transformation, Feature Extraction, Thematic/Spatial Classification, Generalization, GeoStatistics

MAPPING MODULE

This component contains the mapping portrayal services necessary to support the discovery of visualization of NBII resources.

Services to be included: Web Map Viewer, Map Compilation Services, Map Symbolization Services

DISCOVERY MODULE

This component contains the internal search engine as deployed by NBII, however augmented with geospatial search capabilities allowing applications to find primary or secondary sources of information through a Web Map viewer, or the use of Gazetteer services embedded in the search.

Services to be included: Catalog Services, Web Map Viewer, Gazetteers, Geoparsing, Search Engine, Thesauri,



CONTENT LINKING MODULE

This component contains the services as provided by NBII that facilitate the linking of primary sources of data: Map Services, Data Sets and other specially georeferenced data, with the NBII Content Catalog Resources such as Literature Abstracts, Studies, Experts, and other types of information published by the NBII with implied or textual based geographic references.

Services to be included: Catalog Services, Geocoders, Gazetteers, Geoparsers, and Thesauri

NBII ENTERPRISE COMPONENTS

CONTENT CATALOG MODULE

This component contains content of the NBII, and associated services necessary to enable the entities within this catalog to be geospatially discovered, accessed and linked. While the Content catalog exists within the NBII (also known as the NBII Resource Catalog), the current administrative tools for geographically referencing the content need to be augmented with the following services:

Services to be included: NBII Resource Catalog, Catalog Web Services, Geocoders, Gazetteers, Geoparsers, Map Viewers, and Thesauri

COLLABORATION MODULE

This component contains the services as provided by the NBII that facilitate the collaboration using geospatial assets such as map compilations, symbolization schemas, geospatial models, etc.

Services to be included: Map Compilation Management (Web Map Contexts), Map Symbolization Compilation Management (Styled Layer Descriptors), and General Collaboration Services.

FRAMEWORK SERVICES

The following section describes the anticipated services in a fully operational GIF as loosely defined within each component in the previous section. The development of these services will happen within one of three Stages in which the GIF will be rolled out.

For this document, Geospatial services are those that are directly related to the geospatial discovery and use of resources within the NBII. The NBII Enterprise services listed are necessary within NBII but are not exclusive to the GIF, but will need to be integrated into the overall framework. These services are considered within the overall GIF and are included in the design for integration purposes. These NBII Enterprise services will not be developed within the GIF.



GEOSPATIAL SERVICES AND CLIENT APPLICATIONS

WEB MAP VIEWER (S)

This consists of a HTML-based client that will allow the user to dynamically visualize maps from various disparate data sources and applications within a single viewer. The Web Map Viewer will dynamically search the Geospatial Service Catalog for appropriate map sources (WMS, WFS and/or WCS), provide access to basic Gazetteer services for finding placement names on a map, will provide the capability for users to store the map context document for future retrieval and collaboration, and should support changes in map symbolization of WMS services.

WEB MAP SERVICES (WMS)

A Web Map Service (WMS) is a server application used to create and display registered map-like views of information. The server returns to the requesting application via HTTP, information about the capabilities of the server/services, a bitmap image of the requested map, and/or information on a feature within the requested map (if enabled).

WEB FEATURE SERVICES (WFS)

A simple Web Feature Service (WFS) is a server application used to create and display registered map-like views of information. The server returns to the requesting application via HTTP, information described in XML about the capabilities of the server/services, describe the feature types that can be returned, return one or more simple features (point, line, and polygon) described in GML from the requested map. A transaction based Web Feature Service would support all the basic WFS services and have the capability to perform actions on the returned features such as editing or updating of the feature information.

WEB COVERAGE SERVICES (WCS)

A Web Coverage Service is a server application used to create and display registered map-like views of information. The WCS extends the WMS interface to allow access to geospatial "coverages" that represent values or properties of geographic locations, rather than WMS generated maps (pictures). Unlike WMS, which filters and portrays spatial data to return static maps (rendered as pictures by the server), the Web Coverage Service provides available data together with their detailed descriptions; allows complex queries against these data; and returns data with its original semantics (instead of pictures) which can be interpreted, extrapolated, etc. -- and not just portrayed. Unlike WFS, which returns geospatial features, the Web Coverage Service returns representations of space-varying phenomena that relate a spatio-temporal domain to a (possibly multidimensional) range of properties. (i.e. grid layers can be displayed using the WCS.



CATALOG SERVICES

This service allows the storage of geospatial service descriptions, and has a common interface that enables applications to perform discovery, browse and query operations against the catalog servers. Services to be described would include Web Map Services, Web Feature Services, Web Catalog Services, and other services offered within the GIF.

GAZETTEER

A Gazetteer service provides, via HTTP, web access to an authority for place names. For example, the USGS GNIS is an authority for place names within the United States. The service is an implementation of a simple Web Feature Service, and as described above, returns the associated feature representations of the requested place name. The requesting application can then perform actions on the returned feature such as center a Map View within a viewer application, performing a catalog search within the feature of other services within or near the returned feature, or simply, just return information about the feature.

GEOPARSER

A geoparsing service provides web access to keywords and phrases that are contained within a textual document that have a geospatial context. A geoparser provides the capability to search, retrieve and visualize documents and other resources that have not been specifically reference by a feature or set of X,Y coordinates.

GEOCODER

A geocoder service provides web access to locations, traditionally points described with X & Y coordinates, through a process of linking words, terms and codes found within a text string to their application geospatial feature. An address geocode matches the street address to a street segment file, and returns the approximate placement of the address on the matching street segment. A zip code geocode matches the postal Zip Code to the ZIP Code features and returns the center point of the matching point or polygon.

BUFFERING

This geoprocessing service provides a new buffer feature from the provided simple feature based on a few simple parameters such as distance, distance units, and type of buffer (smooth, rough, donut or whole). A buffer service can be used to assist in the centering of maps based on features returned by a gazetteer, can be used to search catalog services for additional maps, and can be used to store or create new items in a Web Feature Service.

MAP COMPILATION SERVICES (WEB MAP CONTEXTS)

The map compilation service will provide web access for users to create, store, and use "state" information from a Web Map Viewer based client application. Using a Web Map Viewer to compile



a map, users may save a Web Map Context document for later use or for collaboration purposes. The map compilation services will allow users to manage their WMC documents in personal and shared spaces within the NBII Enterprise architecture. These WMC documents, when shared with the public, will be included in the Catalog Services and will become searchable resources.

MAP SYMBOLIZATION SERVICES (STYLED LAYER DESCRIPTORS)

The map symbolization service will provide web access for users to create, store, and use an encoded Styled Layer Descriptor (SLD) to change the symbolization of features returned from a Web Map Service (WMS). Using a Web Map Viewers to compile a map, users may save a SLD document for later use or for collaboration purposes. The map symbolization services will allow users to manage their SLD documents in personal and shared spaces within the NBII Enterprise architecture. These SLD documents, when shared with the public, will be included in the Catalog Services and will become searchable resources.

NBII ENTERPRISE SERVICES

GENERAL COLLABORATION SERVICES

NBII has implemented a series of collaboration services that include: document management, discussion lists, project tasks and tracking, and other general collaboration services. The GIF will integrate with these NBII services for any collaborative functionality.

SEARCH ENGINE

NBII has implemented a program-wide search engine through an interface known as BioBot. The BioBot search is a distributed search against multiple resources. BioBot will be extended to include the capability to search based on geospatial parameters, and will also use the catalogs as information sources to return.

THESAURUS

As part of the core NBII Enterprise Architecture, the NBII Biocomplexity Thesaurus Service provides web access to related terms, and is used to assist in the metadata attribution of resources within the NBII Resource Catalog, as well as used within BioBot to return a richer result set from searches.



FRAMEWORK STANDARDS

FRAMEWORK TECHNOLOGIES

The following are base technologies to be used in implementing the NBII Geospatial Interoperability Framework. The list is based both on existing NBII infrastructure and platform requirements for a majority of relevant OGC software products that will be hosted by the NBII program office.

Languages:	Java J2EE (JSP, Servlets, Beans, JDBC, JMS, JNDI, Java XML APIs, RMI)
Markup	HTML, CSS, XML/XSLT, GML
J2EE Application Server:	Tomcat 5
Database:	MS SQL Server 2000, possibly Oracle or PostgreSQL, in the future
Protocols:	HTTP, HTTPS, TCP/IP
Portal/Portlets	Plumtree Portal (Java Version), Portlets (JR-168)
GIS	Mapping and catalog services implementing OGC interfaces, ESRI ArcIMS, Minnesota Map Server, other OGC Compliant GIS Software

GENERAL STANDARDS

ISO 19115

ISO 19115 defines the schema required for describing geographic information and services. It provides information about the identification, extent, quality, spatial and temporal schema, spatial reference, and distribution of digital geographic data. It is applicable to:

- geographic datasets, dataset series, and individual geographic features and feature properties
- the cataloguing of datasets, clearinghouse activities, and the full description of datasets

This schema will be applied by the catalog server to ensure ISO 19115 compliance in the creation of eBRIM dataset metadata records.



FEDERAL GEOGRAPHIC DATA COMMITTEE (FGDC)

This is the Federal Geographic Data Committee standard for geographic data. It defines the record format of datasets in the FGDC Clearinghouse **as well as Geospatial One-Stop**. This is the primary geographic dataset record format to be translated to eBRIM by the catalog server's XML parser. The current FGDC metadata records conform to the ISO **19115**-metadata standard.

ISO 15836 (DUBLIN CORE)

This standard is used as the metadata standard for the NBII Resource Catalog, and is the basis of all records returned from a catalog search. It specifies core elements that the catalog must include in search results. The Dublin Core metadata element set is a standard for cross-domain information resource description, wherein an information resource is defined to be anything that has its own identity; the definition used in Internet RFC 2396, "Uniform Resource Identifiers (URI): Generic Syntax," by Tim Berners-Lee et al. For Dublin Core applications a resource will typically be an electronic document, available on the web.

This standard is for the element set only, which is generally used in the context of a specific project or application. Local or community based requirements and policies may impose additional restrictions, rules, and interpretations. It is not the purpose of this standard to define the detailed criteria by which the element set will be used with specific projects and applications.

BIOLOGICAL DATA STANDARDS

While the development, adoption and adherence to biological data standards are not part of the GIF development, it is worth mentioning, that at a minimum, the following will be supported within Stage One. As new standards are adopted by NBII, a review of the impact of the standard will be performed.

DARWIN CORE AND ACCESS TO BIOLOGICAL COLLECTION DATA

Darwin Core and the Access to Biological Collection Data (ABCD) are two of the more common species occurrence data standards used within the bioinformatics community. These two data standards will be supported within the GIF.

INTEGRATED TAXONOMIC INFORMATION SYSTEM

Integrated Taxonomic Information System (ITIS) is the NBII standard for authoritative taxonomic information on plants, animals, fungi, and microbes of North America and the world. ITIS will be used as the taxonomic standard within the GIF. ITIS can be found at <http://www.itis.usda.gov>



GEOSPATIAL STANDARDS

OPEN GEOSPATIAL CONSORTIUM INC. (OGC) SPECIFICATIONS

The Open Geospatial Consortium Inc. (OGC) is a membership organization dedicated to the development of open system approaches to geoprocessing. OGC creates community-wide specifications for technologies that integrate geoprocessing with the distributed architectures of enterprise and Internet computing.

The chief goal of OGC is to establish a standard set of methods for interacting with each type of service. If ten vendors then build Web Mapping Services, an NBII client can communicate with all of them using a single set of methods and know ahead of time what to expect back. This greatly increases the scope of data resources available to a client application. All OGC client to server communications use a similar XML-based request/response messaging protocol over HTTP POST, though GET versions of these requests are sometimes available as well.

NBII will continue to implement several of its core GIF services with products based on OGC specifications. The catalog service, the integrated catalog client/mapping client and the Web Feature Service based gazetteer described in this document are all based on these protocols.

The specifications for these services can be found at <http://www.opengeospatial.org>.

The specifications directly addressed in Phase I and II of the GIF are described as follows:

Specification	Latest Version	Description	GIF Phase
Catalog Interface (CAT)	2.0	Defines a common interface that enables diverse but conformant applications to perform discovery, browse and query operations against distributed and potentially heterogeneous catalog servers.	I
Catalog Services – ebRIM profile of (CSW)	0.0.9	The OGC Catalogue Services 2.0 specification (OGC 04-021) establishes a framework for implementing catalogue services that can meet the needs of stakeholders in a wide variety of application domains. This application profile is based on the CSW schemas for web-based catalogues and it complies with the requirements of clause 11 in OGC 04-021.	I
Web Mapping Services (WMS)	1.3	Provides three operations protocols (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple sources that are both remote and heterogeneous.	I

Specification	Latest Version	Description	GIF Phase
Web Feature Services (WFS)	1.0	Describes data manipulation operations on Simple Features (feature instances) such that servers and clients can “communicate” at the feature level.	I
Simple Features - SQL (SFS)	1.1	Application Programming Interfaces (APIs) provide for publishing, storage, access, and simple operations on Simple Features (point, line, polygon, multi-point, etc).	I
Gazetteer Service Profile of a WFS (Gaz)	0.0.9	Provides web access to an authority for place names. Returns their associated feature representations.	I
Web Map Context	1.0	Create, store, and use "state" information from a WMS based client application.	I
Styled Layer Descriptors	1.0	An encoding for how the Web Map Server (WMS 1.0 & 1.1) specification can be extended to allow user-defined symbolization of feature data.	I
Web Coverage Services (WCS)	1.0	Extends the Web Map Server (WMS) interface to allow access to geospatial "coverages" that represent values or properties of geographic locations, rather than WMS generated maps (pictures).	II
Coordinate Transformation Services (CT)	1.0	Provides interfaces for general positioning, coordinate systems, and coordinate transformations.	II
Geographic Markup Language (GML)	3.0	An XML encoding for the transport and storage of geographic information, including both the geometry and properties of geographic features.	II
Geocode	0.6.7	The process of linking words, terms and codes found in a text string to their applicable geospatial features, with known locations. (Locations are defined as geometry; usually points with x, y coordinates.)	II
Geoparse	0.7.1	Geoparsing refers to the capability to process a textual document and identify key words and phrases that have a spatial context.	II



ISO 19119

ISO 19119, "Geographic Information - Services," has been developed jointly with the Services Architecture SIG of the OpenGIS Consortium (OGC). As a project in ISO TC211, ISO 19119 has reached the Draft International Specification stage. OGC has adopted ISO 19119 as part of OpenGIS Abstract Specification, Topic 12 "System Architecture." The OGC Web Mapping Testbed activities provided implementation experience in the development of ISO 19119.



This standard categorizes services according to the Geographic Services Taxonomy, making services searchable through the catalog client. These categories will be assigned by the NBII catalog client to eBRIM service metadata records are created. A partial listing of the GST is provided.

<p>Geographic human interaction services</p>	<p>Catalogue viewer. Client service that allows a user to interact with a catalogue to locate, browse, and manage metadata about geographic data or geographic services.</p> <p>Geographic viewer. Client service that allows a user to view one or more feature collections or coverages. This viewer allows a user to interact with map data.</p> <p>Geographic feature editor. Geographic viewer that allows a user to interact with feature data, e.g., displaying, querying. Supports feature annotation.</p>
<p>Geographic model/information management services</p>	<p>Feature access service. Service that provides a client access to and management of a feature store.</p> <p>Map access service. Service that provides a client access to a geographic graphics.</p> <p>Coverage access service. Service that provides a client access to and management of a coverage store.</p> <p>Catalogue service. Service that provides discovery and management services on a store of metadata about instances.</p>
<p>Geographic workflow/task management services</p>	<p>Chain definition service. Service to define a chain and to enable it to be executed by the workflow enactment service.</p> <p>Workflow enactment service. Interprets a chain and controls the instantiation of services and sequencing of activities.</p>

UDDI

The Universal Description, Discovery and Integration (UDDI) specification is one of the major building blocks required for successful Web services. UDDI creates a standard interoperable platform that enables organizations and applications to quickly, easily, and dynamically find and use Web services over the Internet. UDDI also allows operational registries to be maintained for different purposes in different contexts. UDDI registries will be used to for the discover of data



services within NBII as well as a secondary registry for the discovery of the geospatial services within the GIF.

XML

Use of Extensible Markup Language or XML is pervasive throughout the GIF but is most often transparent to the user. Examples are:

- ✓ request/response protocols used for communication between all OGC clients and services.
- ✓ OGC filter syntax
- ✓ structure of capabilities, describeFeature and other OGC “documents”
- ✓ FGDC metadata is based on XML and facilitates validation by system parsers
- ✓ GML returned by a Gazetteer Service using a Web Feature Service profile
- ✓ eBRIM application and profile schemas

FRAMEWORK TOOLKITS

The NBII GIF will produce a toolkit, which will allow NBII Nodes and Partners to access the services of the GIF. The toolkit will be freely distributable without license fees, and will provide a rapid application development environment for basic mapping services, thereby reducing or eliminating the need to invest in proprietary software for basic web mapping applications.

DEVELOPMENT STAGES

Within each stage described below you will find a general description of the types of development activities envisions, with a breakdown between the NBII Program Office and the NBII Nodes and Partners activities.

STAGE ONE

Time Frame: Spring 2005

PROGRAM OFFICE

1. Develop and Install OGC Catalog Service
2. Develop a Gazetteer Service and register it in the OGC Catalog Service
3. Develop and Install a Web Map Viewer, which accesses the OGC Catalog Service for discovery and Gazetteer service for map zooming.



4. Develop a harvesting mechanism to get services from the NBII Resource Catalog for Nodes and Partners and make accessible the Administrative interface to the OGC Catalog Service for GIF administrators

NBII NODE OR PARTNER

1. Nodes enable WMS or WFS service as appropriate on their Internet Mapping Applications
2. Nodes register their Internet Mapping Applications in the NBII Resource Catalog which will be harvested into the OGC Catalog Service
3. Nodes enable their Internet Mapping Applications to discover and use services from the OGC Catalog Service

STAGE TWO

Time Frame: 12-18 months from end of Stage One

PROGRAM OFFICE

1. Integrate Catalog Services with the UDDI Data Catalog Service
2. Modify Web Map Viewer to access and use services from the UDDI Data Catalog Service, such as the NBII DIGIR Web service data.
3. Create a collaboration area and integrate Map Compilation and Map Symbolization management services
4. Create Toolkit for rapid application development for Nodes using Web Map Viewer

NBII NODE OR PARTNER

1. Enable Online Database applications with a Web Service and register them within the UDDI Data Catalog Service
2. Nodes enable WFS or WCS service as appropriate on their Internet Mapping Applications
3. Nodes use Toolkit to create applications, and register them within the appropriate catalog service
4. Nodes develop and register Geoprocessing Services such as Buffering services
5. Nodes enable their Internet Mapping Applications to discover and use services from the OGC Catalog Service, and/or UDDI Data Catalog Service



STAGE THREE

Time Frame: 18-24 months from end of stage two

PROGRAM OFFICE

1. Develop and install a Model Catalog Service
2. Modify Web Map Viewer to access and use services from the Model Catalog Service
3. Modify and Update Toolkit for Rapid Application Development

NBII NODE OR PARTNER

1. Nodes enable or create geospatial or analytical models, and register them in the Model Catalog Service
2. Nodes enable their Internet Mapping Applications to discover and use services from the OGC Catalog Services, UDDI Data Catalog Services, and/or Model Catalog Service.



BIBLIOGRAPHY

- ABCD, Access to Biological Collection Data, Taxonomic Database Working Group (TDWG). Available [online]. <<http://www.bgbm.fu-berlin.de/TDWG/CODATA/default.htm>>
- DCMI, *DCMI Metadata Terms*, DCMI Recommendation (2003-11-19). Available [online]: <<http://dublincore.org/documents/dcmi-terms/>>.
- Darwin Core, Vieglais, David. Available [online]: <<http://speciesanalyst.net/docs/dwc/>>
- EPSG, European Petroleum Survey Group Geodesy Parameters, Lott, R., Ravanas, B., Cain, J., Girbig, J.-P., and Nicolai, R., eds., <<http://www.epsg.org/>>
- FGDC-STD-001-1988, Content Standard for Digital Geospatial Metadata (version 2), US Federal Geographic Data Committee, <<http://www.fgdc.org/metadata/constan.html>>
- IETF RFC 2396 (August 1998), Uniform Resource Identifiers (URI): Generic Syntax, Berners-Lee, T., Fielding, N., and Masinter, L., eds., <<http://www.ietf.org/rfc/rfc2396.txt>>
- IETF RFC 2616 (June 1999), Hypertext Transfer Protocol – HTTP/1.1, Gettys, J., Mogul, J., Frystyk, H., Masinter, L., Leach, P., and Berners-Lee, T., eds., <<http://www.ietf.org/rfc/rfc2616.txt>>
- IETF RFC 2616, Hypertext Transfer Protocol -- HTTP/1.1, Draft Standard (June 1999), available at <<http://www.ietf.org/rfc/rfc2026.txt>>.
- ISO/IEC 11179-3:2003, Information technology – Metadata registries (MDR) – Part 3: Registry metamodel and basic attributes.
- ISO 19101:2002, Geographic information -- Reference model
- ISO 19103 (DTS), Geographic information - Conceptual schema language, (Draft Technical Specification)
- ISO 19106:2002 (DIS), Geographic information - Profiles
- ISO 19108:2002, Geographic information - Temporal schema
- ISO 19109:2002 (DIS), Geographic information - Rules for application schema
- ISO 19110:2001 (DIS), Geographic information - Methodology for feature cataloguing
- ISO 19113:2002, Geographic information - Quality principles
- ISO 19114:2001, (DIS) Geographic information - Quality evaluation procedures
- ISO 19118:2002, (DIS) Geographic information - Encoding



ISO 23950:1998, Information and documentation -- Information retrieval (Z39.50) -- Application service definition and protocol specification

ISO/IEC 19106:2003, Geographic Information – Profiles.

ISO/IEC 19119:2003, Geographic Information – Services.

ISO/IEC 10746 (all parts), Information Technology – Open Distributed Processing –Reference Model.

ISO/IEC 11179-3:2003, Information technology – Metadata registries (MDR) – Part 3: Registry metamodel and basic attributes.

ISO/IEC 8601:2000, Data elements and interchange formats – Information interchange – Representation of dates and times.

ISO/IEC 8825:1990, Information technology -- Open Systems Interconnection -- Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)

ISO/IEC TR 10000-1:1998, Information technology – Framework and taxonomy of International Standardised Profiles – Part 1: General principles and documentation framework.

ISO/IEC TR 10000-2:1998, Information technology – Framework and taxonomy of International Standardised Profiles – Part 2: Principles and Taxonomy for OSI Profiles

ISO/WD 19135, Geographic information – Procedures for registration of geographical information items.

OASIS ebRIM, ebXML Registry Information Model v2.5, Committee Approved Specification (June 2003), available at <<http://www.oasis-open.org/committees/regrep/documents/2.5/specs/ebRim-2.5.pdf>>

OASIS SAML, Assertions and Protocol for the OASIS Security Assertion Markup Language (SAML) V1.1, OASIS Standard (2 September 2003). Available [online]: <<http://www.oasis-open.org/committees/download.php/3406/oasis-sstc-saml-core-1.1.pdf>>.

OASIS XACML, eXtensible Access Control Markup Language (XACML) Version 1.1, OASIS Committee Specification (7 August 2003). Available [online]: <<http://www.oasis-open.org/committees/xacml/repository/cs-xacml-specification-1.1.pdf>>.

OGC 01-009 Coordinate Transformation Service Version 1.0.0 Implementation Specification

OGC 01-026r1, Geocoder Version 0.7.6 Discussion Paper

OGC 01-035, Geoparser Version 0.7.1 Discussion Paper

OGC 01-037, Location Organizer Folder Version 1.0 Discussion Paper



- 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 02-094, Filter Encoding Implementation Specification, version 1.0 (2001-09-19), available at <<http://www.opengis.org/docs/02-059.pdf>>
- OGC 03-003r10, Level 0 Profile of GML3 for WFS Version 0.0.10 Discussion Paper
- OGC 03-022r3, Observations and Measurements Version 0.9.2 Recommendation 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
- OGC 03-081r2, Web Terrain Service Version 0.5 Request for Comment
- OGC 04-010r1 Geolinked Data Access Service Version 0.9.1 Discussion Paper
- OGC 04-011r1 Geolinking Service Version 0.9.1 Discussion Paper
- OGC 04-024, Web Map Service Version 1.3 Implementation Specification
- OGC 99-049, OpenGIS Simple Features Specification for SQL, Revision 1.1 (5 May 1999). Available [online]: <<http://www.opengis.org/docs/99-049.pdf>>.
- OGC 99-113, OGC Abstract Specification Topic 13: Catalogue Services
- OMG 03-03-01, Unified Modeling Language Specification, Version 1.5. Available [online]: <<http://www.omg.org/docs/formal/03-03-01.pdf>>.



OWL-S, OWL-S: Semantic Markup for Web Services, version 1.0 (2003-11). Available [online]: <<http://www.daml.org/services/owl-s/1.0/owl-s.html>>.

RFC 2246, The TLS protocol Version 1.0, IETF Proposed Standard (January 1999). Available [online]: <<http://www.ietf.org/rfc/rfc2246.txt>>.

RFC 2387, The MIME Multipart/Related Content-type, IETF Proposed Standard (August 1998). Available [online]: <<http://www.ietf.org/rfc/rfc2387.txt>>.

RFC 2388, Returning Values from Forms: multipart/form-data, IETF Proposed Standard (August 1998). Available [online]: <<http://www.ietf.org/rfc/rfc2388.txt>>.

RFC 2392, Content-ID and Message-ID Uniform Resource Locators, IETF Proposed Standard (August 1998). Available [online]: <<http://www.ietf.org/rfc/rfc2392.txt>>.

RFC 2396, Uniform Resource Identifiers (URI): Generic Syntax, IETF Draft Standard (August 1998). Available [online]: <<http://www.ietf.org/rfc/rfc2396.txt>>.

RFC 2617, HTTP Authentication: Basic and Digest Access Authentication, IETF Draft Standard (June 1999). Available [online]: <<http://www.ietf.org/rfc/rfc2617.txt>>.

W3C SOAP-1, SOAP Version 1.2 Part 1: Messaging Framework, W3C Recommendation (24 June 2003). Available [online]: <<http://www.w3.org/TR/SOAP/>>.

W3C SOAP-2, SOAP Version 1.2 Part 2: Adjuncts, W3C Recommendation (24 June 2003). Available [online]: <<http://www.w3.org/TR/soap12-part2/>>.

W3C XPath1, XML Path Language (XPath) Version 1.0, W3C Recommendation (16 November 1999). Available [online]: <<http://www.w3.org/TR/xpath>>.

W3C XPointer, XPointer Framework, W3C Recommendation (25 March 2003). Available [online]: <<http://www.w3.org/TR/xptr-framework/>>.

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>>

