Ministry of Forests and Soil Conservation
REDD Implementation Centre

Develop National Database of Basic Attributes of all Forest Management Regimes and Develop National REDD+ Information System or Registry

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System Design and Architecture

Online GIS Platform

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Acronyms and Abbreviations

CF:	Community Forest
CFI	Continuous Forest Inventory
CFOP:	Community Forest Operational Plan
CFUGs:	Community Forest User Groups
CoFM:	Collaborative Forest Management
DBH	Diameter at Breast Height
DBMS	Database Management System
DDC:	District Development Committee
DFO:	District Forest Office/Officer
DFRS	Department of Forests Research and Survey
DOF	Department of Forests
ESMF	Environmental and Social Management Framework
DSCO:	District Soil Conservation Officer
FECOFUN:	Federation of Community Forest Users Nepal
FGD:	Focus Group Discussion
FRA	Forest Resources Assessment of Nepal Project
GHG	Greenhouse Gas Emissions
GIS	Geographic Information System
GLCN	FAO/UNEP Global Land Cover Network
GPG	International Panel on Climate Change: Good Practice Guidance
GPS:	Geographic Positioning System
ICIMOD:	International Center for Integrated Mountain Development
IPs:	Indigenous Peoples
IPCC	Intergovernmental Panel on Climate Change
LCCS	Land Cover Classification System
LhFUGs:	Leasehold Forest User Groups
M and MRV:	Measurement and Monitoring, Reporting and Verification
MIS	Management Information System
MRV	Measuring, Reporting and Verifying
NAFIMS	National Forestry Information Management System
NFCAG	National Forest Carbon Action Group
NEFIN:	Nepal Federation of Indigenous Nationalities
NGO:	Non-Government Organization
NORAD:	Norwegian Agency for Development Cooperation
PSP	Permanent Sample Plots
REDD	Reducing emissions from deforestation and forest degradation
RL/REL	Reference Emission Level
R-PP:	Readiness Preparation Proposal
SLMS	Satellite Land Monitoring System
UNFCC	United Nations Framework Convention on Climate Change
WISDOM	Wood fuel Integrated Supply and Demand Overview Mapping

INTRODUCTION

Traditionally, Geographic Information Systems (GIS) were realized as monolithic and platform dependentapplications (Wong et al., 2002). Recently withthe development of Internet and World Wide Web, GISs haveevolved and adapted to this new environment (Shekhar et al., 2001). The “Online Mapping” or “Online GIS” became asynonym for Web information systems that provides a functionality of geographic informationsystems on the Web through HTTP and HTML (Shanzhen et al., 2002).

Internet allows all levels of society to access geospatial information and provides a media for processing geo-related information with no location restriction(Alesheikh et al,2005). Web GIS should provide functions for displaying and navigation through maps, so asfunctions for querying of geographic data using both spatial and non-spatialcriteria. It is obvious that these functions can cover only some of a GIS functionality stated in(Soomro et al., 1999). Sharing of geospatial data in forestry sector can bedone by updating of existing Desktop based traditionalsystem with the use of “Web interfaces”. An Online GIS that can be connected with wide range of databases with predefined standards Open Geospatial Consortium (OGC) has WMSspecifications (Web Mapping Service for retrieval of maps (Map Service Implementation Specification, 2002) and WFS (Web Feature Service for querying of geospatial data bases.
Forest Sector is one of the widely used sectors for GIS and Mapping purposed. Forest cover, forest change, deforestation, degradation, different management regimes boundaries and other custom maps are very important and useful for forest management and preservation.

1.1 Use-case Diagram

OnlineGIS system that is being presented is used by three classes of users:

a. Simple Web Users
b. Authorized GISUsers
c. Portal Administrators

Simple Web Users are the most general class with the least functionality available. They access the systemthrough a portal for viewing maps and querying geographic features. Online mapping and Querying are not all possible functions, but it is the set of functions aremost suitable. (Stoimenov et al., 2004).

Authorized GIS users have access to all functions of their local GIS applications. A minimum functionality should enable creating of a GIS content that canbe accessed over the portal.Features like viewing and querying, inserting, editing and deleting of some geographic features.

The portal administrator(superadmin) is responsible for defining content that will be available to WebUsers. For that purpose he can specify layer hierarchy depending on a layer type, modify WMS and/or WFS services to the layer.An important feature of thisOnline GIS portal is it can integrate of Geographic information from other servers and system.

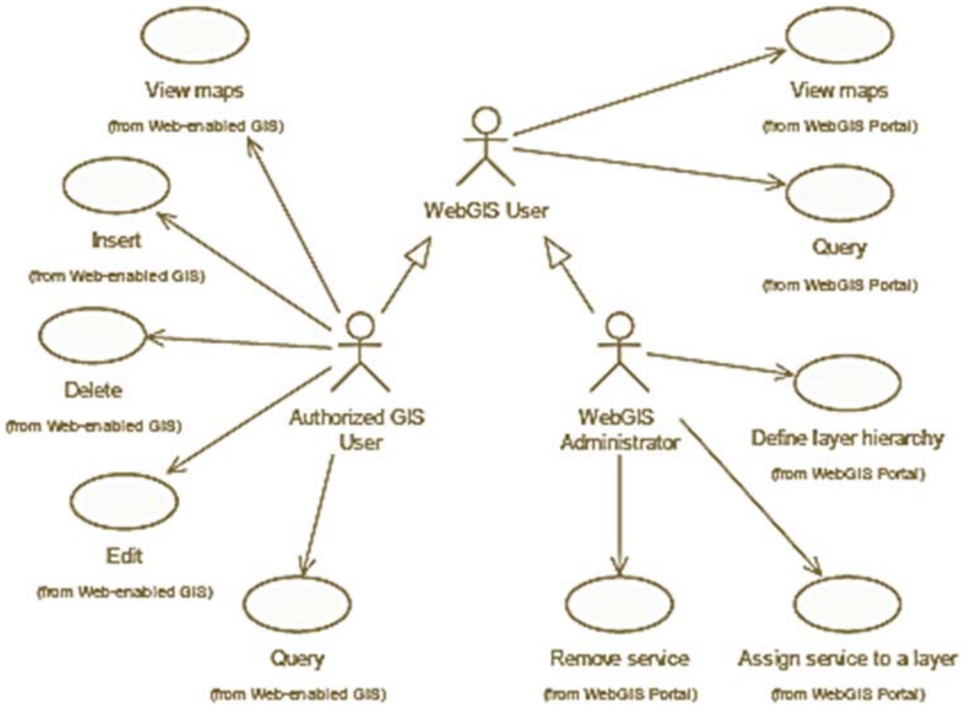

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Figure 1 Use case diagram

1.2 AN ARCHITECTURE NFDNFIS ONLINE-GIS SYSTEM1

To identify subsystems of all forest related GIS data we started from a forestry user requirement analysis.There are several department and GIS data are generated from different sources and organization. Most of the users doesn’t have background of GIS and software. Local level unit have local maps which are more accurate(ie. DFOs, CFUGs) but those maps are not stored in central database. If available they are in different projection, datum which may lead to fragmented spatial information of forest maps.All the maps related GIS data cannot be acquired processed, stored and maintained by one singleorganizational and most of time these mapping data can have mutual and public importance, so itshould be shared and be accessible over Web. This architecture based on client/server model where a subsystem that acts as a client and has access to map portal, while the function of sharing (server) is functioning as expanded traditional GISs with web enabled features of WMS and a WFS.

Internet maps appear like black-box and portalswith infinitely large and deep pools of data. But they aren’t magicalnor mystic, they are built and developed on few standard bits of technology, and these can be re-arranged and obtained from different places. Anyone with little knowledge of interface of mapping and standards can build.
The architecture of NFD NFIS is a way of categorizing the technology pieces that make an internet map work, and building on existing information infrastructures. The key to the architecture is breaking internet mapping into functional layers.

[1] System Environment is used from Open Source Mapping Software and Documentation is based on Open source environment.

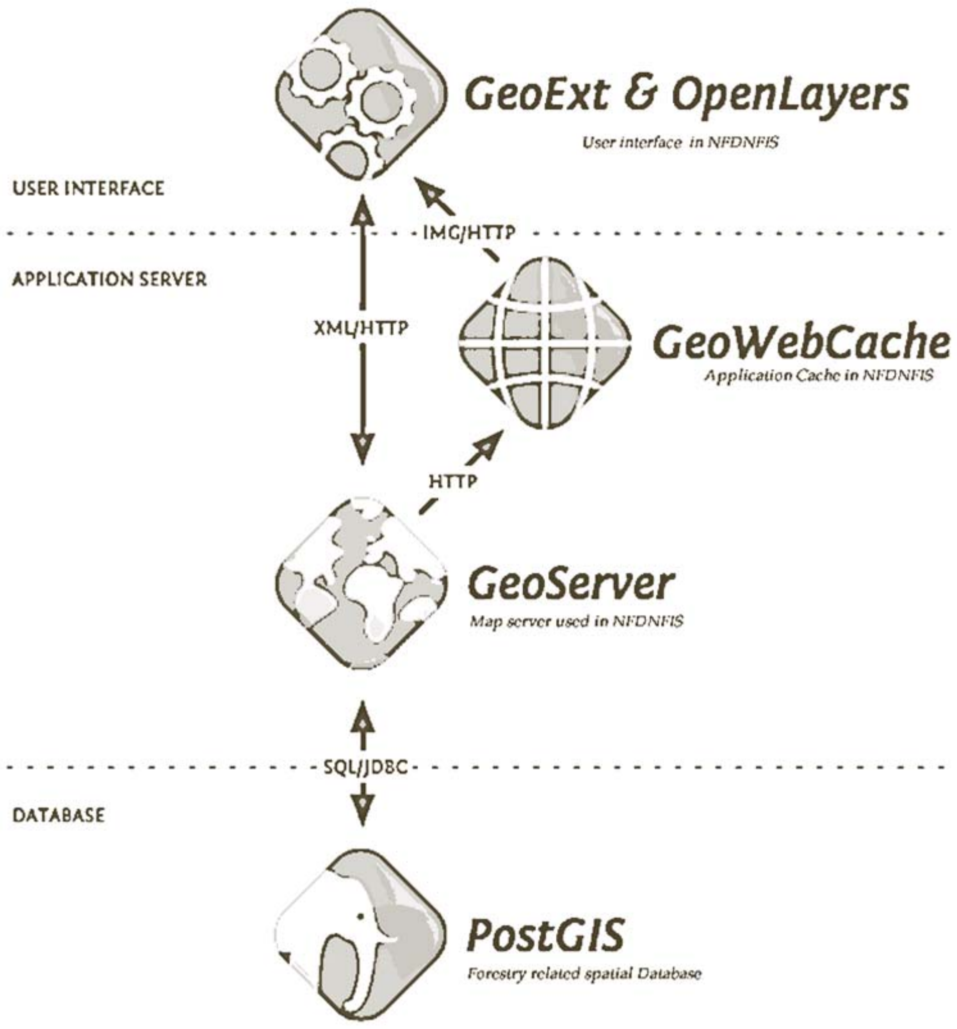


Figure 2 Architecture of NFDNFIS

The functional block of NFDNFIS online mapping portal can be summarized as

- **Storage:** Raw data needs to be managed in a consistent read/write data store, a relational database. NFD NFIS uses the PostGIS spatial database. Raster data of MRV, REL, FRA and satellite image are stored Geocached enabled raster data storage.
- **Application server**: The raw data needs to be accessed using web services, and rendered into cartographic products.[2] NFD NFIS uses the GeoServer map/feature server.

[2] Mapping architecture and document is used from Geoserver and its documents

- **Application cache:** Performance requires the caching of intermediate results, such as map files. NFD NFIS uses the GeoWebCache tile cache.
- **User interface framework:** Targeted vertical applications serve one operational need and serve it well. NFD NFIS uses GeoExt/ExtJS as a platform independent user interface toolkit.
- **User interface map component**: Mapping applications need a map component that understands spatial features and map layers. NFD NFIS uses OpenLayersJavaScript. Other options include Google Maps API and Bing Maps API.

Using these mapping portal departments can utilize according to their requirement

- **Departments with existing GIS systems:**Forest departments which have their own GIS system can build web applications by using their current storage (Spatial data eg.Shape files layer) and put in NFD NFIS application and web interface layers on top.
- **Departments with no GIS systems :** Forest departments which has no their GIS database can integrate mapping into existing enterprise applications by embedding NFD NFIS web components in existing pages and serving maps from the NFD NFIS application layers.
- Google/Bing map tools can deploy all the NFD NFIS storage and application layers to integrate custom spatial information into the consumer-facing Google framework.

Putting maps on the web used to be very difficult. It required specialized software, and more important, specialized knowledge about the kinds of data and processes used to create cartographic products.

The difficulties arose in the gap between the general public understanding of “what is a map” and the geographic specialist understanding of “what is a map”.

A map is made from a number of “layers”, topography, transportation, hydrography, land cover, human construction and so on. The manipulation of these layers and the building of algorithms to analyze them is a field unto itself: “geographic information systems” or “GIS”.

Because the specialists were the first market for web mapping tools, their tools tended to embed the specialist understanding of what comprised a good mapping solution: it should expose multiple layers, the combinations of layers should be quite flexible for the end user, and the end user should provide the data to make the map. Specialists have access to lots of data, and they like to be able to turn their layers on and off.

Members of the general public usually have very simple mapping problems. They have one piece of data (a single “layer”, in the specialist terminology) and they want to see it on a map. Using the specialist web mapping software to achieve their goals is tough, because in order to see their data “on the map”, they first have to build “the map” – the collection of all the things that aren’t their data, but that provide the locational context within which their data resides, generally called a “base map”.

Building a “base map” involves finding all the relevant source data (topography, roads, water, place names, etc) for the working area, and establishing rendering rules (colors, line widths, labeling) for every scale of display. Even for specialists, tracking down data and establishing attractive multi-scale rendering rules can take several days.

Google Maps, Bing Maps, and others, “solved” the general public mapping problem by providing “the map” as a default feature of their technology. They provided the “base map” – initially a simple street map, later augmented with imagery – and the user was expected to provide the rest. The user needed to know a little standard web programming (JavaScript) but needed no special knowledge of GIS data or techniques.

Once freed from the awkward initial step of building their own base map, non-specialists rapidly colonized the online mapping space. As they did, two things happened:

- the clients of the specialists saw the new consumer tools, and wondered why the tools their specialists were providing were so clunky; and,
- The non-specialist’s demands for functionality soon outstripped what Google and Microsoft were willing to provide.

As time goes on, the demands for functionality on the part of non-specialists are moving upwards and converging with the demands of simplicity from organizations formerly served exclusively by specialist GIS staff.

1.3 User Interface

The approach to address the two user’s experts and users should be address properly. Central level has some experts to handle spatial database and can update but in district level the users may only able view and but know the ground reality more precisely. In this fertile middle ground, between complex solutions for experts and restricted solutions for the consumer, we can define a web architecture that plugs into both the specialist and non-specialist use cases. The NFD NFIS web mapping architecture can:

- serve data from specialist databases and files up into the consumer mapping portals;
- store and manipulate data for non-specialists using algorithms formerly only available via expensive GIS software; and,
- Build desktop-like applications (including embedded maps and data capture features) that can be accessed via any web browser.

In all the ways that count, our web architecture is a “GIS”, but it is one that subordinates the “G” to the “IS”. There is nothing extra-special about a “geographic” information system that distinguishes it from an “information system”.

The architectural diagram for a generic web application usually looks like this:

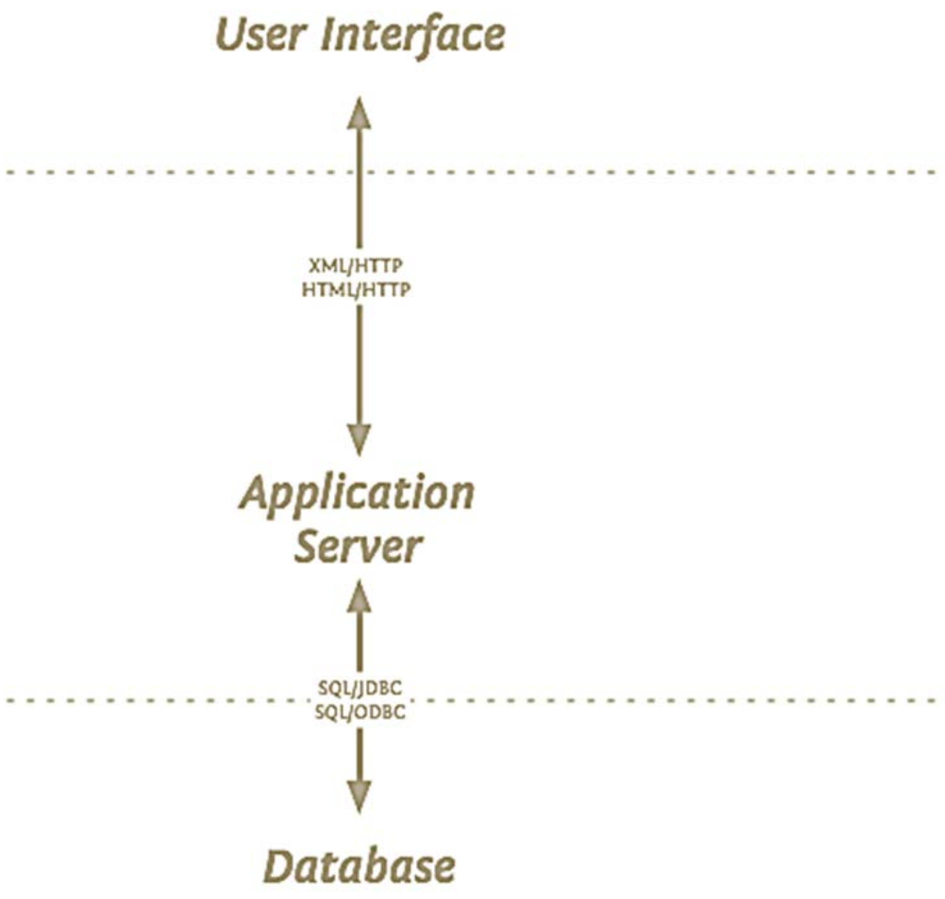


Figure 3 user interface

There is a database or other data storage system at the bottom, some application logic in the middle, and a user interface layer at the top. The database and application layers interact via SQL over a network protocol (specific to the database vendor but usually abstracted away with JDBC or ODBC). The application and the interface layers interact via encoded documents (usually XML or JSON) transferred over HTTP.

Scratch any modern web application, and underneath you'll find architecture like this one.

So, what does the NFD NFIS web mapping architecture look like? It makes use of a set of five open source components, each fulfilling a particular functional role:

- Storage: PostGIS / PostgreSQL spatial database
- Application server: GeoServer map/feature server
- Application cache: GeoWebCache tile cache
- User interface framework: GeoExt / ExtJS
- User interface map component: OpenLayers

At the bottom of the NFD NFIS architecture there is a database (PostGIS) or file-based storage system, there are application servers in the middle (GeoServer and GeoWebCache), and there's a user interface layer on the top (OpenLayers and GeoExt).

The database and application servers interact via SQL (with Open Geospatial Consortium standard spatial extensions). The applications servers and user interface layers interact via standard web encodings (XML, JSON, images) over an HTTP transport.

The web mapping architecture is distinguished from standard application architecture, not in the arrangement or classification of the parts, but in what the parts do.

- The PostGIS database can answer spatial queries as well as standard attribute queries.
- The GeoServer map/feature server can provide standardized web access to underlying GIS data sources.
- The GeoWebCache tile server can intelligently store and serve map tiles using standard web protocols for requests and responses.
- The GeoExt/ExtJS interface framework includes standard UI components and also specific bindings for spatial features.
- The OpenLayers map component can consume maps from multiple sources and provides tools for data editing and capture.

A key feature of the NFD NFIS architecture is that, through the use of standards, any component of the architecture can be replaced with other products. For organizations with existing software infrastructure, this feature is a necessity.

- For storage, PostGIS can be swapped with Oracle Spatial, SQL Server Spatial, DB2 Spatial or ArcSDE.
- For web map access, GeoServer can be swapped with MapServer, ArcGIS Server, MapGuide or any other WMS-capable map renderer.
- For web feature access, GeoServer can be swapped with Ionic Red Spider, CubeWerx or any other fully featured Web Feature Server (WFS).
- For caching, GeoWebCache can be swapped with TileCache.
- For user map components, OpenLayers can be swapped with Google Maps, Bing Maps, and other components.

NFD NFIS Data Layer

2.1PostGIS

NFD NFIS uses the PostGIS, a spatial extension of PostgreSQL which is based on open source software architecture. PostgreSQL / PostGIS is a compliant with the Open Geospatial Consortium "Simple Features for SQL" specification.

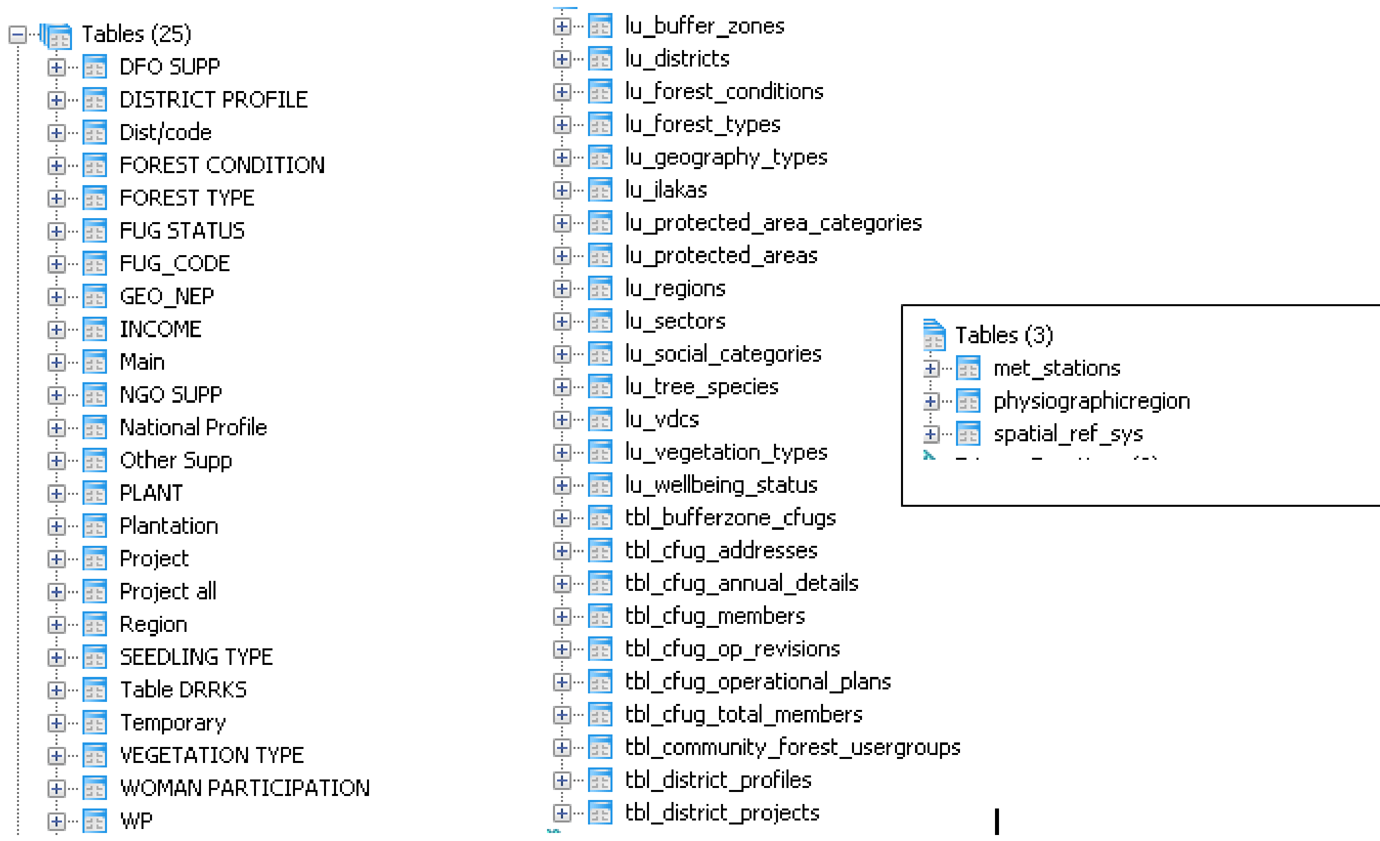
PostGIS is an extension to the PostgreSQL object-relational database system which allows GIS (Geographic Information Systems) objects to be stored in the database. PostGIS includes support for GiST-based R-Tree spatial indexes, and functions for analysis and processing of GIS objects.(http://postgis.net/docs/manual-2.0/)

Some features of PostGIS2 are

- Supportsother standard query standards like SQL92 standards.
- HasTransactional integrity and also has disaster recovery. Data andfile corruption is less.
- Has Security and authentication infrastructure based on roles.
- Supports backups and replication.
- External access through standard protocols (JDBC, ODBC) and different standard languages (C, C++, Python, C#, Java, PHP, QGIS, ARCGIS etc).

In addition, PostGIS adds types, functions and indexes to support the storage, management, and analysis of geospatial objects: points, line strings, polygons, multipoint, multiline strings, multipolygons and geometry collections.

As a spatial database, PostGIS can store very large contiguous areas of spatial data, and provide read/write random access to that data. This is an improvement over old file-based management structures that were restricted by file-size limitations and the need to lock the whole files during write operations.



Tables (25)
- DFO SUPP
- DISTRICT PROFILE
- Dist/code
- FOREST CONDITION
- FOREST TYPE
- FUG STATUS
- FUG_CODE
- GEO_NEP
- INCOME
- Main
- NGO SUPP
- National Profile
- Other Supp
- PLANT
- Plantation
- Project
- Project all
- Region
- SEEDLING TYPE
- Table DRRKS
- Temporary
- VEGETATION TYPE
- WOMAN PARTICIPATION
- WP

- lu_buffer_zones
- lu_districts
- lu_forest_conditions
- lu_forest_types
- lu_geography_types
- lu_ilakas
- lu_protected_area_categories
- lu_protected_areas
- lu_regions
- lu_sectors
- lu_social_categories
- lu_tree_species
- lu_vdcs
- lu_vegetation_types
- lu_wellbeing_status
- tbl_bufferzone_cfugs
- tbl_cfug_addresses
- tbl_cfug_annual_details
- tbl_cfug_members
- tbl_cfug_op_revisions
- tbl_cfug_operational_plans
- tbl_cfug_total_members
- tbl_community_forest_usergroups
- tbl_district_profiles
- tbl_district_projects

Tables (3)
- met_stations
- physiographicregion
- spatial_ref_sys

Figure 4 CFUG database in PostgreSQL both spatial and Non spatial database stored.

2.2 Other Databases

There may be exist different files and data for spatial objects in different formats. This application can store and integrate those like.

- Oracle Spatial
- Raster Maps of classified images
- StandardShapefile
- MSSQL Server(Spatial) and
- MySQL Spatial

For organizations with some existing database/ Mapping systems, deploying GeoServer on top of their current database is the easiest way to get on the geospatial web without reorganizing their infrastructure.

2.3 Other Data Sources

While databases offer the strongest combination of data integrity, integrated analysis and support for write operations, many organizations use GIS file formats to hold their data.

GeoServer can read from and write to (with some limitations on concurrency) GIS files:

- Image File Formats
- GeoTIFF
- ECW
- EsriShapefiles
- JPEG2000
- JPG/PNG/GIF

In addition, it can read data directly from standard protocol services e.g. Map published by department of Survey, ICIMOD,USGS and Global Forest Watch layers using

- OGC Web Map Service (WMS) for imageryand maps.
- OGC Web Feature Service (WFS) for vector features.

2.4 WMS/KML Service on PostGIS

Providing data for other users to integrate can be hard, if the data are constantly changing. Dumping a file out to adatabase works fine, but what if the data are changing every minute as new information streams in automatically? What about people who use Google Earth for visualization? What will be the map of CFUGs when it is changed or updated?

Thisarchitecturehas simplesystem that allows multiple tools for visualization, and maintains information.

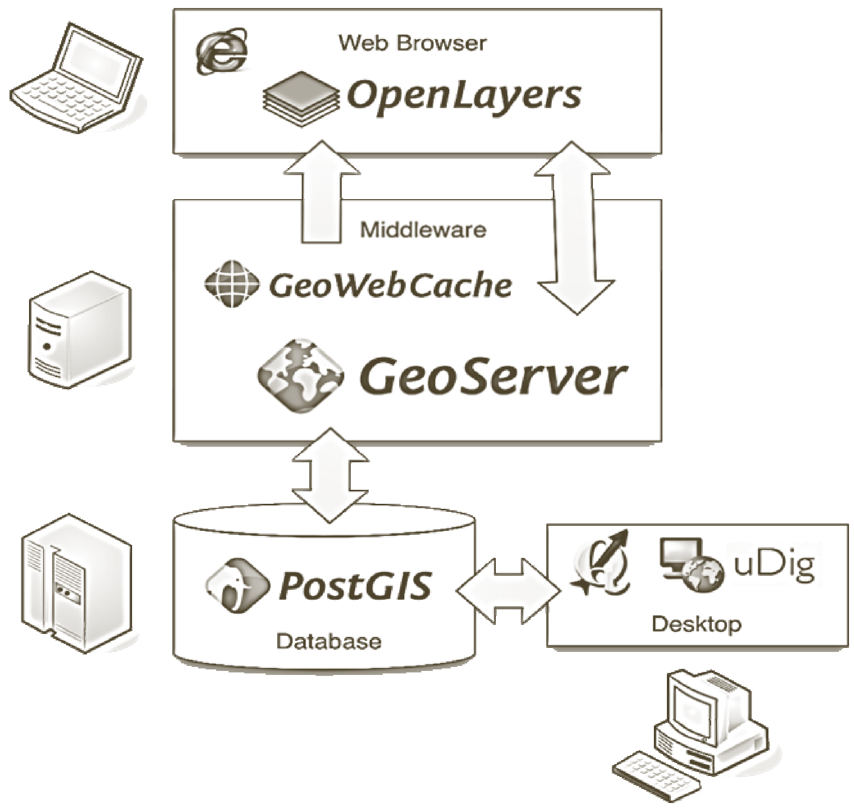


Figure 5 WMS WFS work flow

At the bottom of this architecture is the PostGIS spatial database. The data inputs are piped into PostGIS by converting the data stream to SQL “update” statements that update an asset location table in the database. To maintain a history of locations, a simple “on update” trigger copies the location as an “insert” to an asset history table. (More advanced systems will also partition the history table, to manage the size issues created by continuous data streams.)

On top of PostGIS, we add GeoServer. Configure the asset location table as a data source, and add any styling we want for the location points (symbols, circles, pixmaps, etc).

That is it for configuration! Everything else is done by end-users.

End-users can view the asset locations in:

- ArcMap, by adding the GeoServer WMS service to their application as a “WMS layer”;
- Google Earth, by adding the GeoServer WMS service to their application using a KML output type;
- Google Maps, by entering the URL of the GeoServer KML service into the Google Maps search field; or,

- Any other client software (there are 100s) that support consuming WMS services as an input data source.

3 NFD NFIS Application Server Layer

The application server layer is responsible for mediating between the data layer and the user interface layer (UI). It acts as a protocol gateway, turning standard web requests from the UI into the specific calls necessary to talk to databases or read from GIS files. It also is a repository for custom logic, like processing services, and other application-specific routines.
Boundless supports the GeoServer spatial application server as the best building block for spatial web services, and the GeoWebCache tile server as an accelerator for custom map services.

3.1 GeoServer

GeoServer can read from multiple data sources, generate multiple output formats, and communicate using multiple standard protocols. As such, it fits easily into existing infrastructures, providing a communication path between old and new software components.

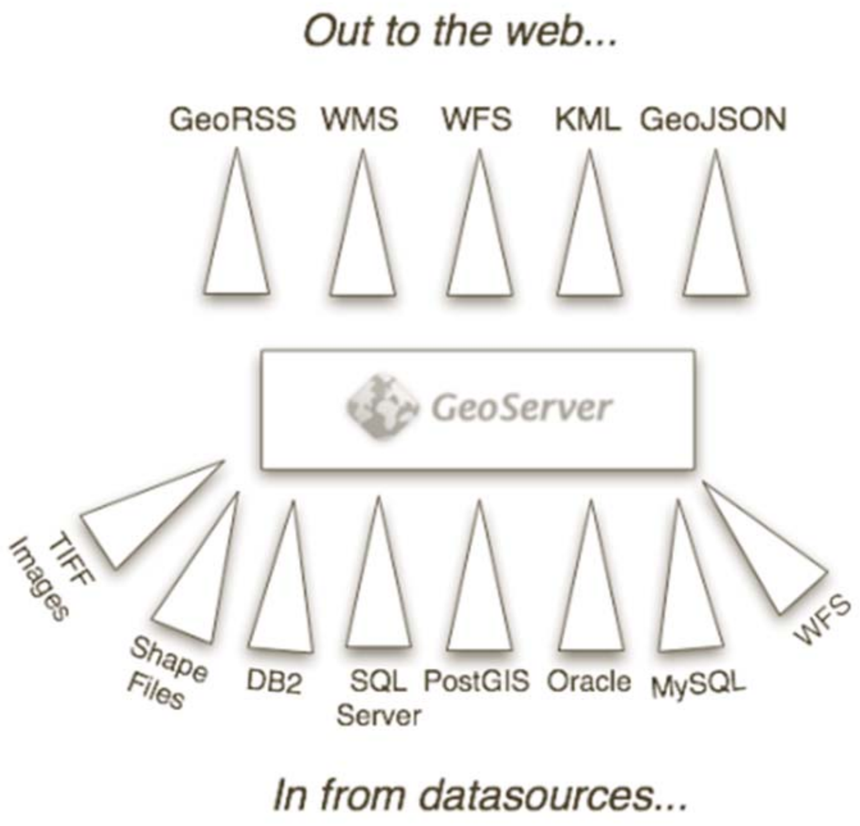


Figure 6GeoServer input and outputs formats

Like the Apache web server, which provides an HTTP access method for files and services, GeoServer provides an HTTP access method for geospatial objects and queries on those objects. As such, it allows standard web technologies – Javascript, web browsers, scripting languages, anything that speaks HTTP (and that is almost everything) – to work with spatial information in an intelligent way.

GeoServer presents spatial data (tables in a database, files on a hard drive) as feature collections, and allows HTTP clients to perform operations on those collections.

- Render them to an image, as an attractive cartography product.
- Apply a logical filter to them and retrieve a subset, or a summary.
- Retrieve them in multiple formats (KML, GML, GeoJSON).

Without GeoServer, when building a spatial web application, the developer would be required to write all the code between the web server and the database/files. With GeoServer, the developer can use a few standard access patterns to retrieve maps and information.

The access standards GeoServer implements include:

- OGC Web Map Server (WMS) for retrieving cartographic images;
- OGC Web Feature Server (WFS) for querying and retrieving vector feature collections;
- OGC Styled Layer Descriptors (SLD) for encoding cartographic styling rules;
- OGC Filter specification for encoding subset queries on feature collections;
- OGC KML for encoding feature collections for visualization in Google Earth;
- OGC Geographic Markup Language (GML) for encoding feature collections for general purpose re-use.

All these standards are internationally recognized and approved.

3.2 GeoWebCache

Like GeoServer, GeoWebCache is a protocol gateway. GeoWebCache sits between tiled mapping components (like OpenLayers, Google Maps and Bing Maps) and rendering engine in GeoServer.

Tiled map components generate a large number of parallel requests for map tiles, and the tiles always have the same bounds, so they are prime candidates for caching. GeoWebCache receives tile requests, checks its internal cache to see if it already has a copy of the response, returns it if it does, or delegates to the rendering engine (GeoServer) if it does not.

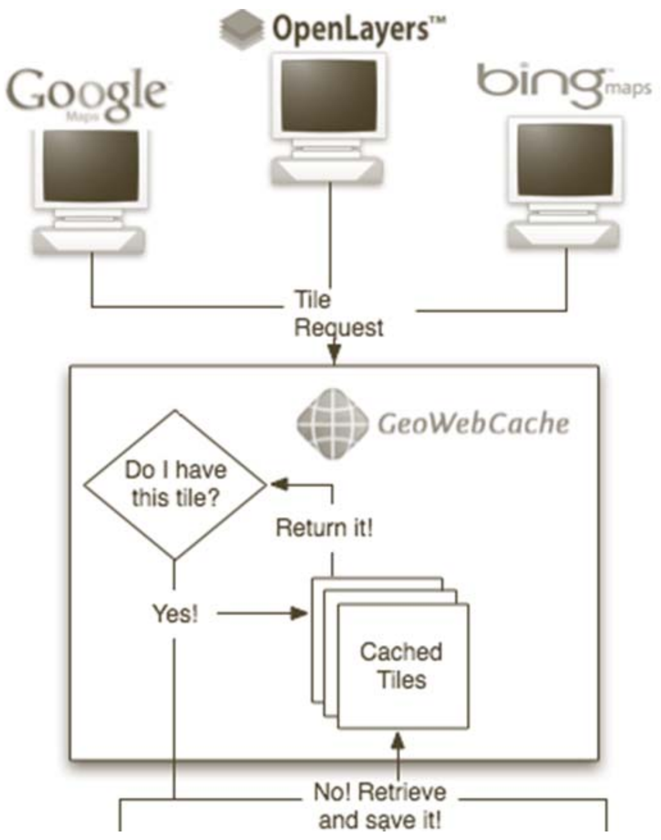


Figure 7Geowebcache work flow

When GeoWebCache delegates rendering requests to the rendering engine, it uses standard WMS requests. As a result, it can be used with any engine that supports WMS (ArcServer, MapServer, MapGuide, etc). GeoWebCache supports tile requests from all the common tiled map components, so it can be used equally well under applications using OpenLayers, Google Maps, Bing Maps or Google Earth.

3.3 Other Application Servers

Because NFD NFIS is configured to use standard protocols for data access and delivery, it is possible to substitute alternate components, or create architectures that use multiple components. Map rendering from PostGIS data sources to a WMS interface can be done by GeoServer, but it can also be done by MapServer, or by ArcServer (9.2 or greater). Using NFD NFIS, architectures can mix and match different application servers depending on their relevant strengths.

4. Architecture Examples

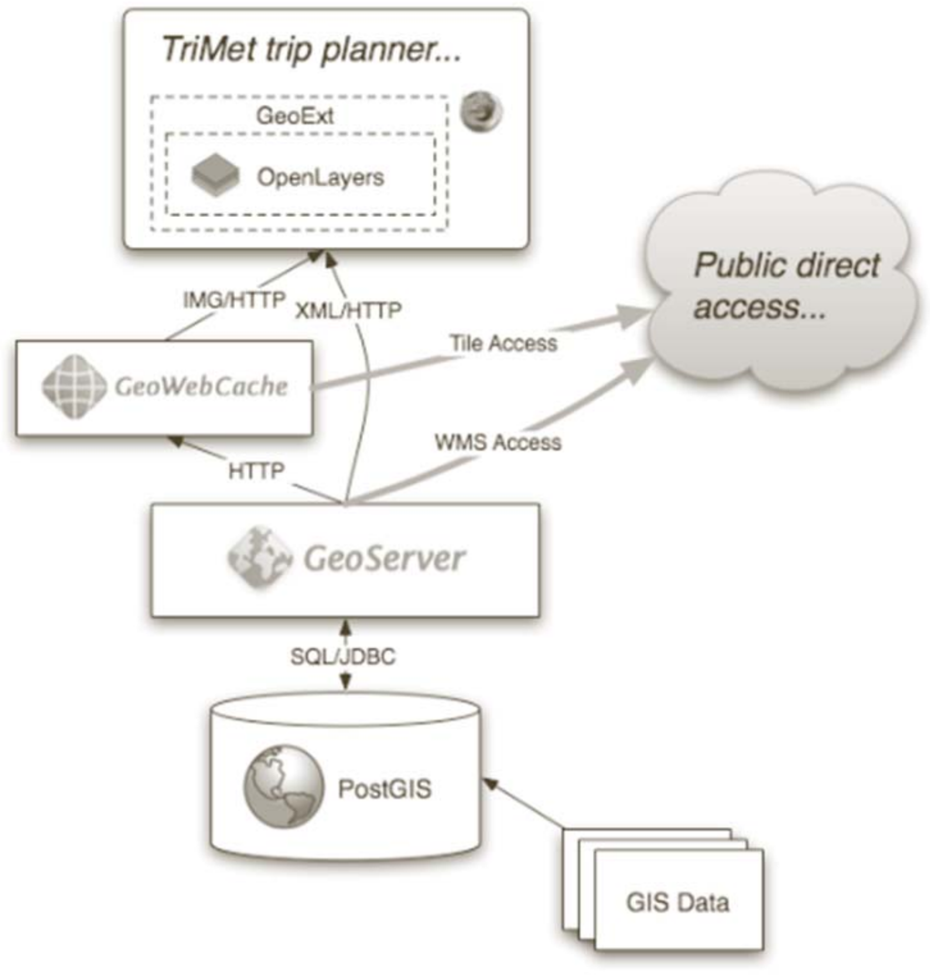


Figure 8 Architecture Examples

At the bottom of the architecture, the relevant spatial is loaded into PostGIS and updated on regular schedule. This is primarily to provide a consistent interface (SQL) for the data from all other components of the architecture, as well as a single points of truth.

On top of PostGIS, GeoServer provides rendering to cartographic map output, which is exposed via the standard WMS interface. The WMS interface is public, which means that users other than REDD can make direct use of the maps.

On top of GeoServer, GeoWebCache turns tile requests from OpenLayers into WMS requests to GeoServer and caches the results for performance.

On top of GeoWebCache, OpenLayers is the mapping component, embedded within a GeoExt framework providing user interface components like expandable trays, fold-out panels and more standard user interface elements.

Because each element of the interface is standardized, it is possible for external organizations to include components of the NFDNFIS system in their own applications. It is also easier for NFDNFIS to roll out new applications, using the same architectural base of services.

4.1 User Interface Layer

It uses the OpenLayers Javascript map library and the GeoExt Javascript user interface library. Both libraries are 100% client-side implementations of user interface components: OpenLayers providing a map component and associated infrastructure (map editing tools, spatial object formats, and more); and, GeoExt, tying OpenLayers into the rich user interface structure of ExtJS.

Highly interactive user interfaces have been the province of desktop software, or plug-in oriented web clients (Flash, or Java applets). With the arrival of high-performance Javascript engines in browsers, and complex user interface libraries like ExtJS, it is now possible to bring the interactivity of desktop applications to the web. Old web applications required frequent slow page refreshes and reloads, but applications build with 100% client-side Javascript do not.

The advantage of web applications is ease of deployment and update. Updating a desktop application can take weeks of installs on many computers. Updating a web application requires deploying the code to one server. Now that the finish quality of web applications equals that of desktop applications, there is no reason not to use the web.

4.1.1 OpenLayers

OpenLayers is a generic mapping component, designed to consume spatial data and maps from numerous sources and display that data in a web browser. Unlike Google Maps or Bing Maps, OpenLayers is not tied to a particular map source. It can display maps from Google, Microsoft or Yahoo!, and also display custom maps generated by rendering engines like GeoServer, MapGuide, MapServer or ArcServer.

In addition to map display, OpenLayers offers tools for working with spatial data directly in the browser and tools for manipulating those features on the screen: digitizing, altering, and moving features.

4.1.2 GeoExt

ExtJS is a popular client-side Javascript library for building user interfaces. Like desktop toolkits, it includes pre-built components for trees, lists, panels, tables, dialogues and so on.

GeoExt adds extensions to ExtJS that bind basic ExtJS components to the spatial features of OpenLayers. For example, a GeoExt "selection manager" which looks like a table in the user interface is bound to the set of selected features in OpenLayers.

The GeoExt set of components allows Boundless to rapidly develop custom spatial applications, because we don't have to constantly re-write the bindings between the map component and the other user interface components – we just use (or enhance) the existing GeoExt work.

4.1.3 Other User Interface Layers

The map components from Google, Microsoft, Yahoo and others can all be used in place of OpenLayers in NFD NFIS. Because GeoServer and GeoWebCache speak standard web protocols and formats, it is easy to build a site that uses Google Maps for visualization, but GeoServer for map rendering and query processing.

4.1.4 A Multi-Layer Data Viewer

It is common for an organization to want to validate older vector data against newer ground truth. The public availability of image data at Google Maps and Bing Maps has made the prospect even more tantalizing if only the organization's data could be overlaid with the corporate imagery to check it!

Our suggested architecture makes use of GeoServer to render the organization's GIS data, from files, or existing databases, or PostGIS, whichever makes the most sense.

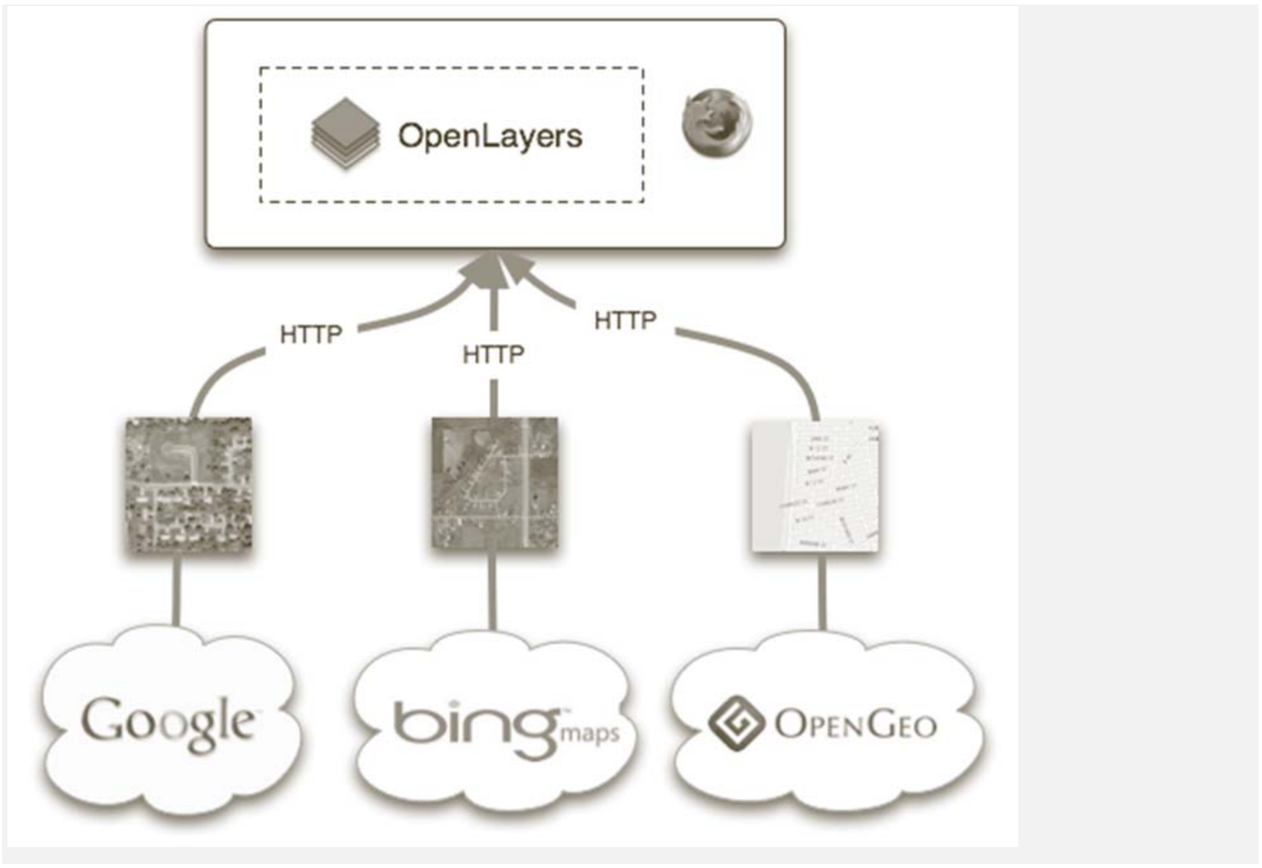


Figure 9 A Multi-Layer Data Viewer

OpenLayers is then configured with three (or more) layers: base map layers from Microsoft and Google, and an overlay layer provided by GeoServer.
Additionally, because OpenLayers reads from OGC standard WMS sources, any WMS-capable rendering engine (MapServer, MapGuide, and ArcGIS Server) could be used in place of GeoServer.

On the page where we want the map, we embed OpenLayers, by adding a named <div> tag to the existing code. OpenLayers pulls a base map from Google, and renders an overlay map of business features via GeoServer, which in turn pulls data directly from Oracle.
The OpenLayers map is controlled with a small amount of Javascript on the business application page that takes in a record identifier from the business application converts it to a WFS query via OpenLayers, which is passed to GeoServer that returns an extent to zoom the OpenLayers map .