

A Grid-enabled Architecture for Geospatial Data Sharing

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Outline

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Introduction

- Geospatial data - a class of data that has a geographic or spatial nature
- Geospatial data sharing
 - Main issue: interoperability
- Open Geospatial Consortium (OGC)
 - Web Coverage Services (WCS)
 - Web Feature Services (WFS)
 - Web Map Services (WMS)
 - Catalogue Services (CSW)

- Grid technologies and infrastructures
 - Domain-independent efforts which aim at a much broader "resource sharing and problem solving in dynamic, multi-institutional virtual organizations"
 - OGSA, OGSF, WSRF
- OGC vs. Grid
 - OGC: focus more on interface specifications and encodings for the access to geospatial data sources
 - Grid: focus more on the collaboration and sharing of resources in a controlled and secure manner
- Our goal: to leverage each other's strengths for geospatial data sharing

Background

- OGC web services
 - WFS: access to map features (vector data)
 - Some basic operations: getCapabilities, describeFeatureType, getFeature,...
 - WMS: access to maps encoded as pictures in raster formats like GIF, JPEG,...
 - WCS: access to coverage data (values or properties of geographic locations)
 - CSW: catalogue service for the publishing and discovery of other services

- *Grid services*

- Each resource in *OGSA* is represented as a *Grid service*
- *OGSI* further specifies the basic interfaces to be implemented by *Grid services*, e.g., *GridService (GS)*...
- Each *Grid service* instance is identified by its handle (*GSH*) and reference (*GSR*)
- A service instance can be created through the invocation of a specific *Grid service "factory"*
- *OGSA-DAI/DQP*: for data access and integration over the *Grids*
 - *OGSA-DAI*: *Grid Data Service (GDS)*, *Grid Data Transport (GDT)*,...
 - *OGSA-DQP*: *Grid Distributed Query Service (GDQS)*, and *Grid Query Evaluation Service (GQES)*

"Grid-enabling" OGC web services

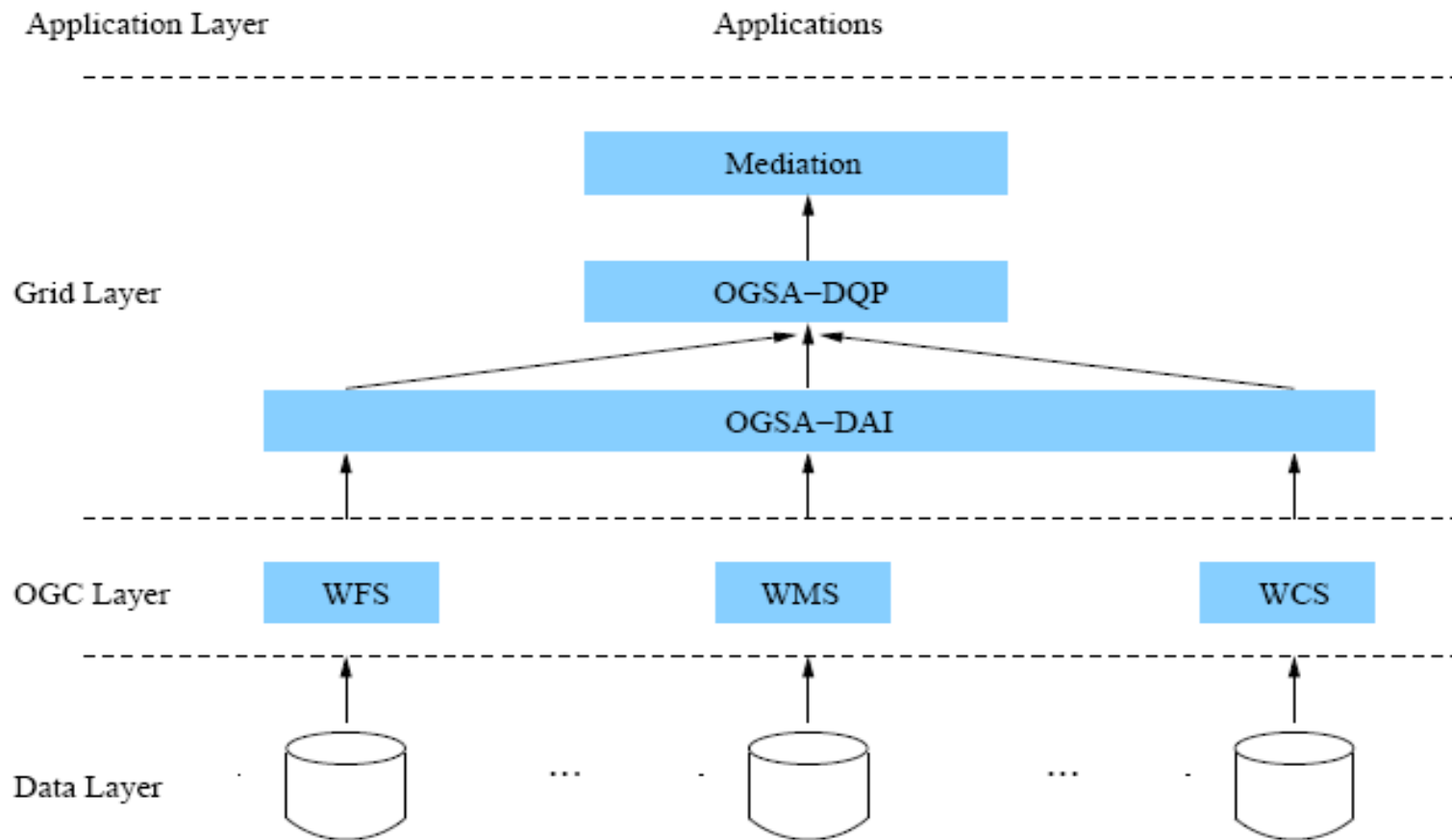


Fig. The Grid-enabled architecture

- The architecture:
 - Data layer
 - consists of a set of autonomous, distributed geospatial data sources (e.g., ESRI shapefile, PostGIS,...)
 - OGC layer
 - Hides the heterogeneities among different geospatial data sources
 - Exposes to the upper layer as OGC-compliant web services such as WFS, WMS, and WCS
 - Grid layer
 - Builds upon OGSA-DAI and OGSA-DQP
 - OGC web services are exposed as Grid services
 - Introduce a mediation module which includes two new services, Schema Mapping Service (SMS) and Mediator Service (MS)
 - Application layer
 - Performs some data intensive operations

Integrating with non-Grid-enabled OGC web services

- OGC web services can be cascaded
 - E.g., a WFS can use another WFS as its feature source; a WMS can act as a WMS client and combine contents from several WFSs
 - The advantage: contents and capabilities of several services can be aggregated
- Our method: to make the cascaded OGC web services Grid-enabled and use them as gateways to non-Grid-enabled OGC web services
 - Parse the request (sent through the SOAP over HTTP), extract parameters, repackage them, and send over HTTP (i.e., HTTP GET and POST)

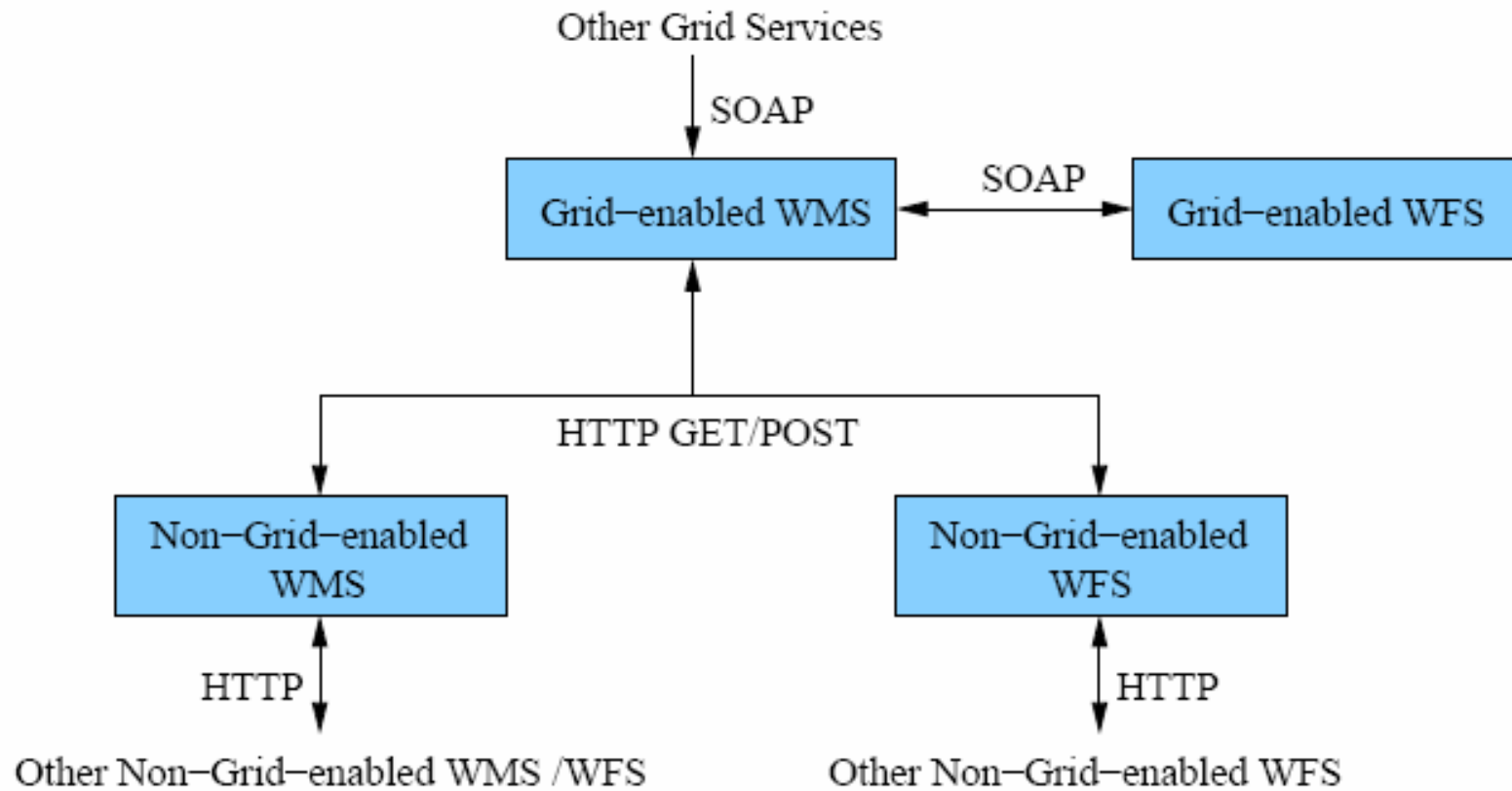


Fig. Integration with non-Grid-enabled OGC Web services

Implementation Status

- An environmental case study: WildNet
- The WildNet database contains 3.5 million records of wildlife sightings and listings of around 20,000 species
- Sightings visualization
 - Sightings can be visualized on a map for a specific area
- Species distribution modelling
 - Through the analysis of the sightings data with the environmental data

- Two steps
 - OGC compliance
 - Grid enabling
- Implementation
 - GeoServer: the server-side WFS server development
 - uDig: the client-side interface development
 - Basic WFS requests are supported using Java Servlet technology under Eclipse + Tomcat
 - Implement a simple catalogue service
 - Keyword-based
 - Location-sensitive

Conclusion and Future Work

- Explored the integration of OGC and Grid technologies for geospatial data sharing
- Proposed a Grid-enabled architecture based on both technologies
- Discussed how Grid-enabled OGC web services can be integrated with non-Grid-enabled ones
- Future work
 - Full implementation of the case study based on OGSA-DAI/DQP
 - More efforts on large-scale data sharing