DISTRIBUTED WEB GIS SERVICE BASED ON XML AND INTEROPERABILITY

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ABSTRACT

Web GIS (Geographic Information Systems) service systems provide the various GIS services of analyzing and displaying the spatial data with friendly user-interface. These services are expanding the business domain and many users want to access the distributed various spatial data. But, it is difficult to access diverse data sources because of different spatial data format and data access methods. In this paper, we design and implement web GIS services based on the inter-operability and GML (Geography Markup Language) of OGC(Open GIS Consortium) in web distributed environment. Inter-operability provides unique accessing method to distributed data sources based on OLE DB technology of Microsoft. In addition, GML support web GIS services based on XML. We design these GIS services as components using UML (Unified Modeling Language) of an object-oriented modeling language for specifying, visualizing, constructing, and documenting the artifacts of software system. In addition, they also were developed in object-oriented computing environment, and it provides the interoperability, language-independent, easy developing environment as well as re-usability.

Keywords : GIS, Interoperability, OLE DB

1. INRODUCTION

Web GIS(Geographic Information Systems) is expanding the class of user with the advantage of the friendly user interface environment and various geographical operations, topological analysis. But, because of closing-style system architecture these systems don't support the interoperability. That is, there is a lack of interoperability between them because most of them have their own unique data format according to their application fields. This brings about the duplication of data construction. The practical use of Constructed already GIS data drop being been subordinate in GIS package and caused by the GIS data format and the type of DBMS.

OGC(Open GIS Consortium) proposes the open service architecture of web GIS to support data-interoperability. It suggests the GML (Geographic Markup Language) based on XML(eXtended Markup Language) to exchange the data between the web client and the web GIS [2].

And, OLE DB technology of Microsoft provides unique accessing method to distributed data sources. OLE DB uses the Component Object Model (COM) infrastructure, which reduces unnecessary duplication of services and provides a higher degree of interoperability, not only among diverse information sources [1][3].

In this paper, we describe the GML and OLE DB technologies for interoperability in GIS domain. And we present our developed components based these technologies. The rest of the paper is organized as follows. Section 2 discusses two technologies for interoperability. Section 3 describes system architectures of our web GIS environment, Finally, Section 4 consider the advanced technologies for interoperability in GIS domain.

2. BACKGROUND

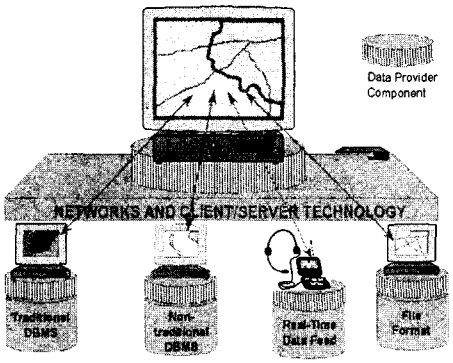
This paper is described using two opened studies. One is OLE DB and the other is GML based on XML

OLE DB is set of Component Object Model (COM) interfaces that provide applications with uniform access to data stored in diverse information sources and that also provide the ability to implement additional database services [3].

There are three fundamental categorizations of software – Data Providers, Service Providers, Consumers.

The Data Provider category is the most fundamental set of components that must be implemented in order to allow geographic data to be shared among different applications. These applications may be as diverse as

data collection, analysis or simple viewing. With OLE DB interfaces to relevant geographic data, customers and other software vendors will be able to view and analyze heterogeneous collections of data from a wide range of data sources without first trying to convert them all to a compatible data format[1]. Service Providers include spatial query processors, buffer zone services, geocoding services, or network analysis services. And, Consumer is application or tools. [Figure 1] shows the concept of data provider component.



[Figure 1] Data Provider Component

GML is an XML encoding for the transport and storage of geographic information, including both the spatial and non-spatial properties of geographic features [2].

GML uses the W3C XML Schema Definition Language to define and constrain the contents of its XML documents. The GML v2.0 Specification defines some basic conformance requirements for users to develop their own application schemas. Software applications attempting to process any arbitrary GML user application schema must understand GML and all of the technologies upon which GML depends, including the W3C XML Schema [2][4].

This specification defines the XML Schema syntax, mechanism, and conventions that provide an open, vendor-neutral framework for the definition of geospatial application schemas and object. And, it allows profiles that support proper subsets of GML Framework descriptive capabilities. [Figure 2] shows the example of GML feature schema.

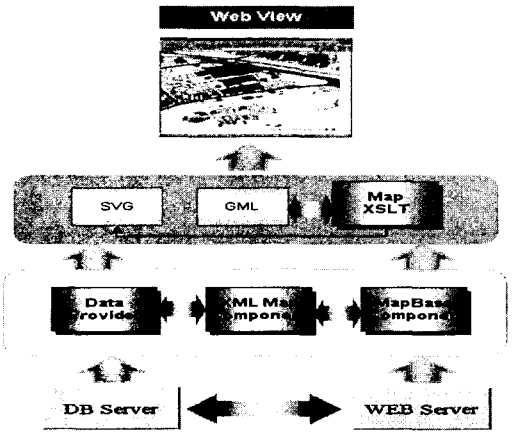
```
<my:Road
        xmlns:my="http://www.ned.dem.csiro.au/XMML"  xmlns:gml="http://www.opengis.net/gml"
        xmlns:xlink="http://www.w3.org/1999/xlink"
        xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
        xsi:schemaLocation="http://www.ned.dem.csiro.au/XMML /road.xsd"
        gml:id="H23">
 <gml:description>An example of a simple Road feature</gml:description>
 <gml:name>Oliver Highway</gml:name>
 <my:nLanes>8</my:nLanes>
 <my:number>M99</my:number>
 <my:surfaceTreatment>gravel</my:surfaceTreatment>
 <my:centreLine>
  <gml:LineString srsName="epsg:4256">
   <gml:coordinates>23.0,45.9 23.1,46.6 23.5,48.2</gml:coordinates>
  </gml:LineString>
 </my:centreLine>
 <my:destination>Leederville, W.A.</my:destination>
 <my:destination xlink:href="urn:au:gov:geoscience:places:Canberra"/>
</my:Road>
```

[Figure 2] The example of GML Feature Schema : Road

3. SYSTEM ARCHITECTURE

[Figure 3] describes system architecture of our web GIS. There are four layers which process the spatial

data – data source layer, data provider layer, data conversion layer, and data display layer.



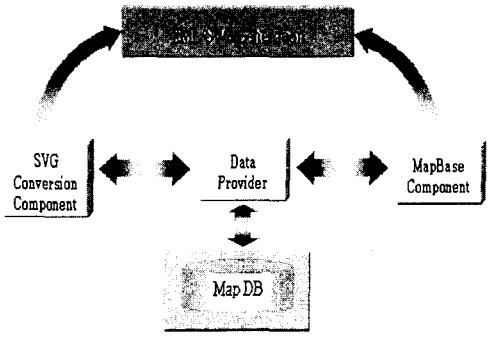
[Figure3] System Architecture

Data source layer consists of DB Server and WEB Server. DB Server is composed of the distributed data sources have the spatial data and non-spatial data. That is, our web GIS was developed based on the distributed environment. And Web Server provides various these data of DB Server via Internet.

Data provider layer is the set of the components implemented based on specifications of Microsoft's OLE DB. Data provider components have metadata about the spatial data. These metadata are what are feature tables, what is column of spatial in feature table, what is the spatial reference system of feature table , which operation is supported by data source layer, and what is extents of feature table.

Data conversion layer have two components. One is the conversion between spatial data of data source and GML. The other is between spatial data of data source and SVG.

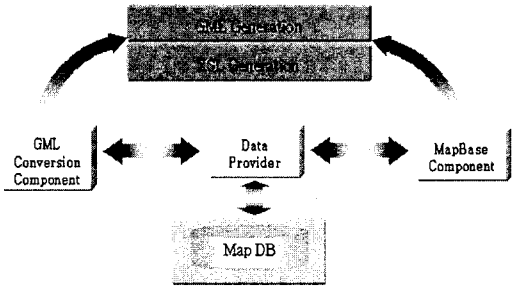
SVG is graphic standard of displaying XML announced by W3C [5]. The role of SVG is displaying the GML and graphic contents based on XML in the web application. This SVG component converts the spatial data from data providers to SVG format. [Figure 4] presents SVG conversion component.



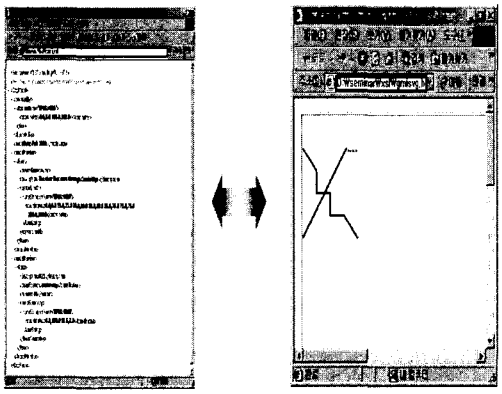
[Figure 4] SVG Conversion Component

GML component convert the spatial data from data providers to GML format . But, GML doesn't have the styling information because of the standard displaying spatial data as XML contents . So, we have developed the GML-SVG XSLT component . It converts the GML contents to SVG to displaying GML contents as two-dimension object in web . [Figure 5] and [Figure 6] describes GML Conversion component and the example of GML-SVG XSLT . Using GML-SVG XSLT, the styling information of GML is automatically produced. The color and depth of line are the examples of styling

information.

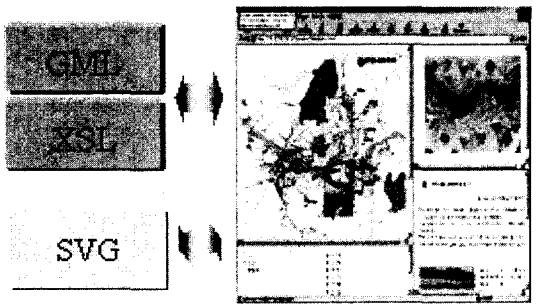


[Figure 5] GML Conversion Component



[Figure 6] Example of GML-SVG XSLT

Data display layer is web view template component displaying GML and SVG contents . This template has the fundamental mapping functions and SVG services. In addition, it is possible to convert automatically GML to SVG without XSLT. [Figure 7] presents web view template component.



[Figure 7] Example of GML-SVG XSLT

4. CONCLUSION

We designed and developed the distributed web GIS services based on the GML and interoperability.

OLE DB technology provides system architecture model related to interoperability. This model provider unique interfaces accessing the spatial and non-spatial data in distributed data sources. Especially, clients can access and retrieve GIS data source support the different GIS data format using data provider component based on OLE-DB technology.

OGC publishes the GML based on XML as vector data format transmitted from server to client. We developed the conversion components between web data contents. This component support the description of spatial application schemas for specialized domains and information communities And increase the ability of organizations to share geographic application schema and the information they describe.

We modeled multiple components using the UML. The components were implemented with ATL/COM provides the environment of the language-independency. These components can be appropriately composed to the web GIS application, and they have advantages of the reusability and interoperability. The reusability guarantees the low cost of the software development and

the interoperability shares the data between diverse GIS data server.

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