The Interoperability of Location-Tracking Service based on Geographic Information

Do Hyun KIM and Byung Tae JANG, Korea

Key words: Interoperability, Location-Tracking, GIS

SUMMARY

Tracking Service based on geographic and location information are expanding the business area gradually. This service collects the location of moving object and present it on geographic map. To support this tracking service, it is necessary that the interoperation of the location information and the geographic information which are distributed servers. But, the inter-relation of these servers is very difficult because of the closed system architecture, different information format, and the absence of interoperability technologies. In this paper, we suggest the interoperability method to provide the location-tracking service based on distributed data source.

The Interoperability of Location-Tracking Service based on Geographic Information

Do Hyun KIM and Byung Tae JANG, Korea

1. INTRODUCTION

Today, according as the volume of location increases gradually, efficient tracking of objects is important. Many research and development for this investment have done in worldwide. Specially, location information is very the useful element depending on situation that high-speed data communication technology of Wireless LAN, IMT2000 etc.

The tracking based on the location includes the past and the future estimate for position as well as the present. Field that can use location information of the moving object efficiently is location-based tracking analysis service. So, we developed the location-tracking service system which collect the location of the moving object and analyze it. This effort enlarges the requirement about the cooperation between LBS (Location-Based Service) and GIS (Geographic Information Systems).

But, the existing LBS and GIS server have been dependently developed and provided on specific system of a network infrastructure. To provide the tracking services based on the various geographic data models, it is necessary to develop the method of integrating the location information and distributed geographic data.

GIS 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.

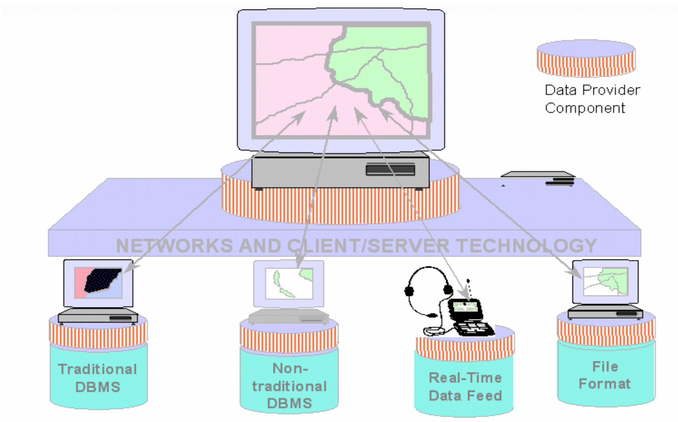
OGC(Open GIS Consortium) proposes the open service architecture of web GIS to support data-interoperability. It suggests the GML (Geographic Markup Language) based on XML(eXtended Markup Language) to exchange the data between the web client and the web GIS [1].

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 [2][3].

In this paper, we describe the GML and OLE DB technologies for interoperability in GIS domain. And we also describe the tracking service based on the moving object's location combining the intelligence GIS system and location based services. The rest of the paper is organized as follows. In section 2, we discuss two technologies for interoperability. In section 3, we propose the architecture of our tracking service system. . We verify the effectiveness of the suggest architecture in section 4 and conclude in section 5

2. DATA INTEROPERABILITY

In this section, we describe 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. 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. Service Providers include spatial query processors, buffer zone services, geocoding services, or network analysis services. And, Consumer is application or tools. [Picture 1] shows the concept of data provider component.



Picture 1 Data Provider Component

OGC announced OLE DB provider implementation specification in order to support interfaces that could be freely accessible to GIS data on distributed computing environment. This implementation specification says that we firstly must implement the Microsoft OLE DB interfaces and then we must extend these interfaces to OGC requirements usually composed of spatial engine functions.

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

3. THE ARCHITECUTE AND IMPLEMENTATION

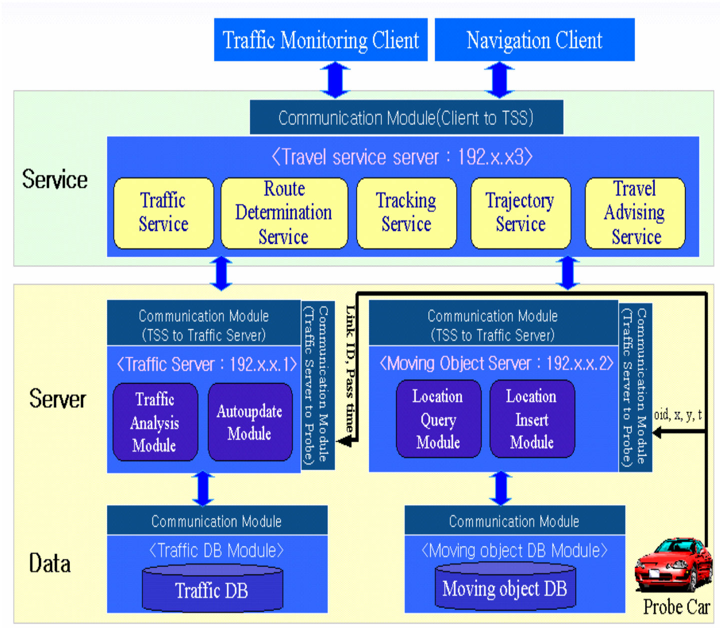
Our tracking services based on the location is designed in distributed web service. This system receives the GML-styled document and parameter as the request of client and provides the vector data, GML-styled document, and image map data. There are three processing phases. PUBLISH phase is registering the service content and functions to registering server. Clients send XML request is consisted of the service capability and functionality to registering server. This is FIND. Finally, Bind is connecting the client and service server [5-6].

Our traffic and tracing service system do multitasking modules of server for processing tasks of each request at the same time each client when service request from multiplex clients is given. For this server architecture, web service modules and server modules are designed as components.

Our system do multitasking modules of server for processing tasks of each request at the same time each client when service request from multiplex clients is given. For this server architecture, web service modules and server modules are designed as components.

[Picture 2] presents the system architecture of Tracking Service Server. This system is consisted of data layer, server layer, and Service layer. Data layer provides static road network data and traffic information, and trajectory location trace. Road network data are collected from various GIS via data providers.

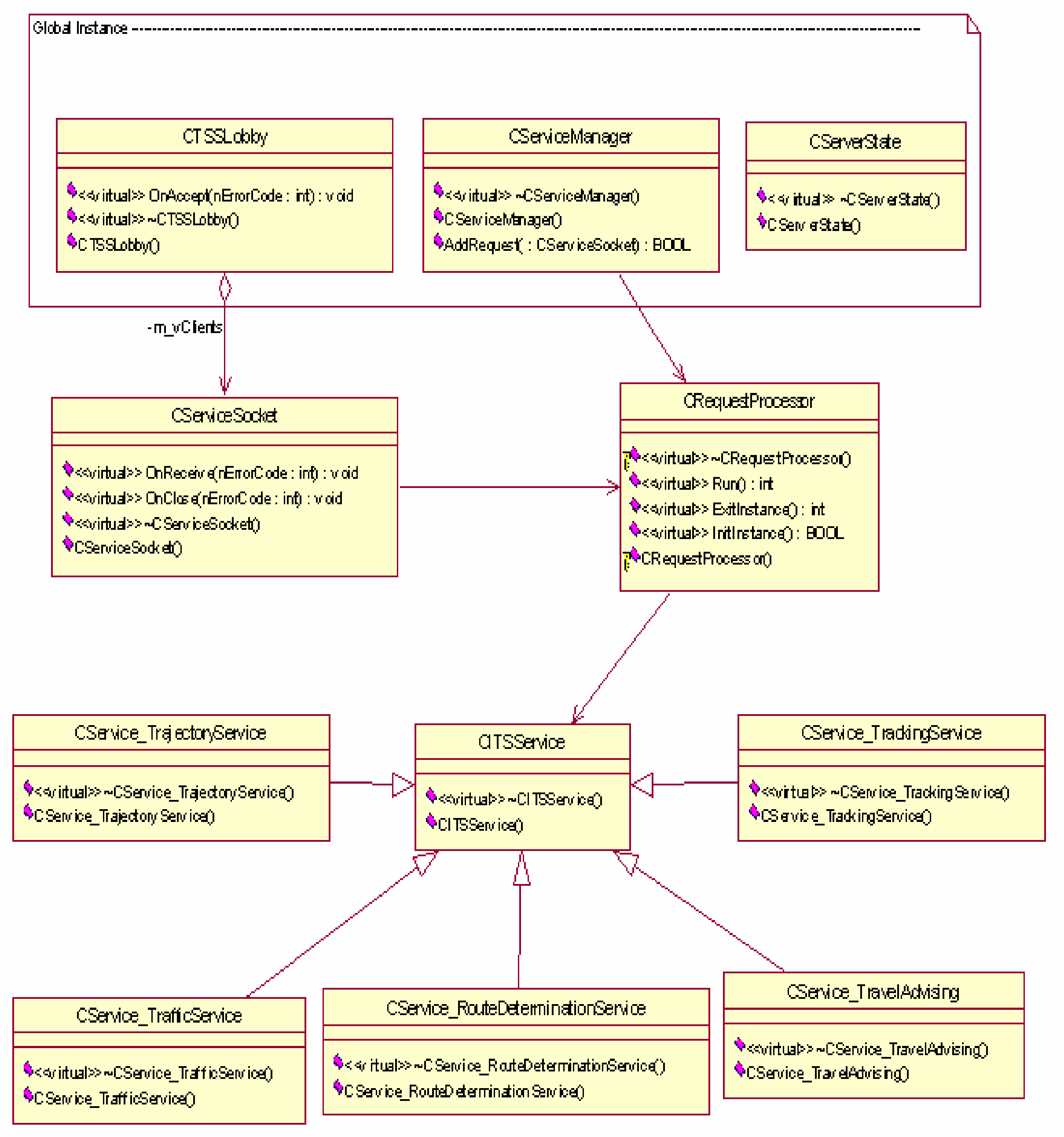
Server layer supports the various analyzing functions of circulating shortest path, processing traffic information, and tracing location. This layer receives the traffic information and the location data from data server and provides the analyzing result to service layer. This layer is composed of WTS(Web Traffic Server) and WMOS(Web Mobile Object Server)



Picture 2 System Configuration of OGC OLE DB Component

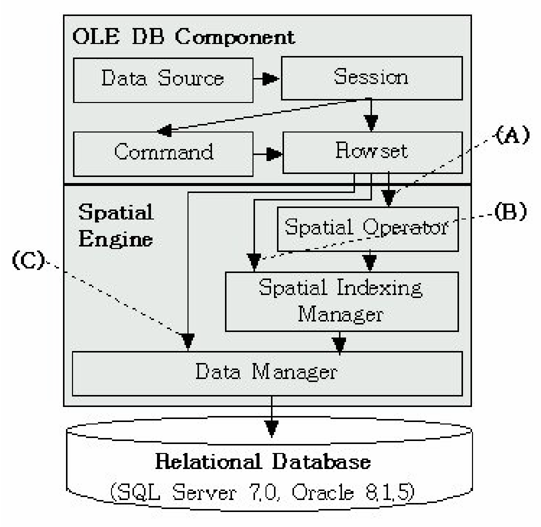
WMOS is composed of MOS(Moving Object Server), TSS(Travel Service Server), and SOAP-XML Web Server. MOS is collecting the location of moving objects. This location information has the geographic coordinate, the collection time, and the identification number of moving object. TSS processes the request of tracing particular moving object. SOAP-XML Web Server receives SOAP request and return the XML-styled location information of moving object. Request processing phase is following. First, client call function based SOAP, and then SOAP module makes the message of doing location request. TSS is receiving this message from SOAP module, and distributes it in pre-created thread. The thread is connecting to MOS, and sends the query for requesting the location information. Figure 4 describes the thread-processing of MOS.

WTS is composed of TS(Traffic Server), TSS(Travel Service Server), and Web Server supporting SOAP and HTTP Web Server. TS is collecting the location of moving objects from MOS and processing this for making the velocity of the specific section of road. This velocity information is used to route the shortest path based time. SOAP-XML Web Server receives SOAP request and return the XML-styled location information of moving object. Request processing phase is following. First, client call function based SOAP, and then SOAP module makes the message of doing traffic information request. TSS is receiving this message from SOAP module, and distributes it in pre-created thread. The thread is connecting to TSS, and sends the query for requesting the traffic information. [Picture 3] represents the design of our system using UML.



Picture 3 The UML model of the tracking service system

OLE DB component specification announced by Microsoft exposes the standard interfaces for accessing to global data server, so public users are guaranteed to access a variety of relational databases or file systems in the same manner through the standard interfaces. In addition to this standard OLE DB component specification, OGC's OLE DB component requires modified and extended interfaces for satisfying OGC's GIS concerned functionality. Extended OLE DB component specification leaves OLE DB component interfaces as it is, additionally must provide user with GIS concerned functions. For this GIS concerned functions, we additionally implemented a spatial engine in this study.



Picture 4 System Configuration of OGC OLE DB Component

As shown the [Picture 4], OLE DB component consists of data source, session, command and rowset objects. Data source object initializes database and sets up the connection to database. Session object obtains the database concerned meta information and creates a command object for running the SQL statements. Command object executes SQL statements, processes SQL parameters and creates rowset objects as a result of SQL statements. Rowset object plays a role of management of result features that transferred from database as a result of command object. And let's look at the detail process and roles of RDBMS, spatial engine and OLE DB component.

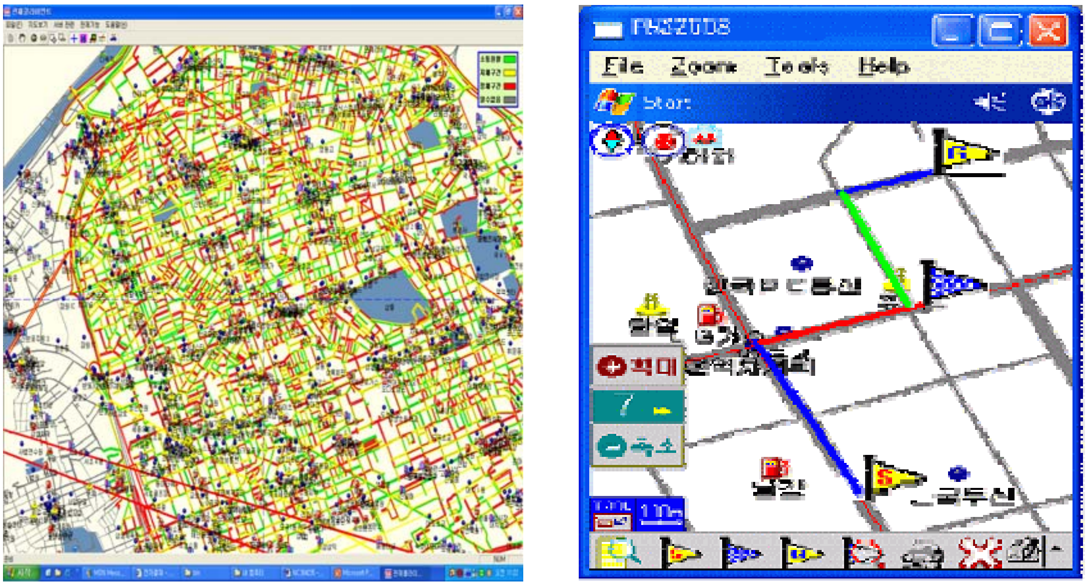
- OGC requires that data provider component should provide various meta information about what GIS features exist in the GIS server, what is geometry column's name of feature table, what spatial reference systems are supported for each feature and what is each feature table's column schema. As these meta information could be obtained through *IDBSchemaRowset* interface of session object, session object of pure OLE DB component have to be extended so as to accommodate the meta information. In [Picture 4], meta information could be easily obtained by calling**(C)** data manager of spatial engine.

- OGC requires that data provider component should provide 9 spatial operators using spatial filter. This spatial filter function demands three SQL parameters of 'spatial filter object', 'spatial operator' and 'feature table's geometry column name'. Actually ICommandWithParameters interface of command object processes these three parameters and asks spatial indexing manager and spatial operator of spatial engine for processing these spatial filtering functions. Therefore, such spatial indexing manager for processing spatial filter is indispensable to spatial engine and R*-tree indexing methodology is implemented in this study. In this [Picture 4], this functions are processed through the flow (A) or (B).

- OGC also requires that WKB(Well-Known Binary) typed geometry information and WKT(Well-Known Text) typed spatial reference system information are provided by data provider component. Data manager of spatial engine also has to process these functions through the flow **(C)**.

4. EXECUTION

This system is implemented as server-side components providing traffic services and tracing services based on designed architecture in session 3. components have the layered architecture and relationship with each other. The result is provided as various format is subject to application environments. [Picture 5] presents the execution in desktop PC and mobile terminal.



Picture 5 Execution

5. CONCLUSION

In this paper, We developed the tracking service server based distributed GIS data via interoperability technologies. Our system is composed of WTS and WMOS. WTS is composed of TS(Traffic Server), TSS(Travel Service Server). And WMOS is composed of MOS(Moving Object Server), TSS(Travel Service Server).

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.

In addition, , we designed the system as multiple components using the UML and developed it. The components designing the Open GIS Service were implemented with ATL/COM provides the environment of the language-independency . This components can be appropriately composed to the application, and they have advantages of the reusability. The reusability guarantees the low cost of the software development.

REFERENCES

[1] Simon Cox, Adrian Cuthbert, Ron Lake, Richard Martell. Eds, Geography Markup Language (GML) 2.0, Open GIS Consortium Inc, 2001

[2] OpenGIS Consortium Inc, OpenGIS Simple Features Specification For OLE/COM, 1999

[3] Microsoft Press, Microsoft OLE DB 2.0 Programmer's Reference and Data Access SDK, 1998

[4] Henry S. Thompson, David Beech, Murray Maloney, and Noah Mendelsohn. Eds, XML Schema Part 1: Structures. W3C Recommendation, 2001

[5] W3C, *SOAP version 1.2 Part 1: Message Framework*, http://www.w3.org/TR/2003/REC-soap12-part1-20030624, 2003

[6] W3C, *Web Service Description Language(WSDL) Version 2.0 Part 1: Core Language*, http://www.w3.org/TR/2005/WD-wsdl20-20050510/, 2005

CONTACTS

The Interoperability of Location-Tracking Service based on Geographic Information
Do-Hyun Kim, Byung-Tae Jang
Telematics Research Group, Telematics & USN Research Division, Electronics and Telecommunications Research Institute(ETRI)
161 Gajeong-Dong, Yuseong-Gu
Daejon
KOREA
Tel. + 82 042 860 5529
Fax + 82 042 869 1608
Email:dohyun@etri.re.kr, jbt@etri.re.kr
Website: www.etri.re.kr