

Address Geocoding Service in Chinese Taipei

-A Case of SOA-based Web Application Development

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Abstract

Taiwan's Ministry of the Interior (MOI) began to establish a national system for inquiry on coordinate values of spatial locations of building addresses through SOA (Service-oriented Architecture) based geocoding of addresses around Taiwan in 2009. The inquiry system of address locations is in a two-level structure, that is, application systems access the inquiry service component of Taiwan Geospatial One Stop (TGOS) at the first level and then, after TGOS 4A module (Authentication, Authorization, Accounting and Auditing) certification, are connected to the server and database for a county or city at the second level to obtain the locational coordinate values of the target addresses.

After the inquiry system of address locations is completed, developers of application systems for various government agencies do not need to collect and process address data to find out coordinates of address locations for specific administrative purposes. In addition, users can obtain real-time and complete data on locations of addresses from widely distributed local-level platforms through the national-level inquiry system of address locations, an Internet-based one-stop portal and mechanism for sharing geospatial data and minimizing duplication of efforts to set up databases.

The inquiry system makes central government units not responsible for collection and management of data, and makes the best use of existing address databases, incurring less costs of hardware and databases than field surveys of addresses. Furthermore, the inquiry system is a demonstration case of the cooperation between the central and local governments to promote SOA application, paving a way for boosting the integration of e-government with national GIS functions.

Keywords: Taiwan Geospatial One Stop (TGOS), Service-oriented Architecture (SOA), geocoding service

1. Foreword

MOI began to offer subsidies for local governments to set up databases of building addresses and corresponding inquiry systems in 1998. The databases for 25 counties and cities in Taiwan, containing 8 million addresses in total, were all completed in 2009 at a total subsidization amount of NT\$600 million (about US\$18 million). Because the numbering of addresses in most rural areas was irregular and/or unsystematic, every address was assigned with a coordinate value to secure the accuracy of address data. The address databases can be used for many administrative purposes, including civic service, police, fire fighting, urban planning, taxation and public work.

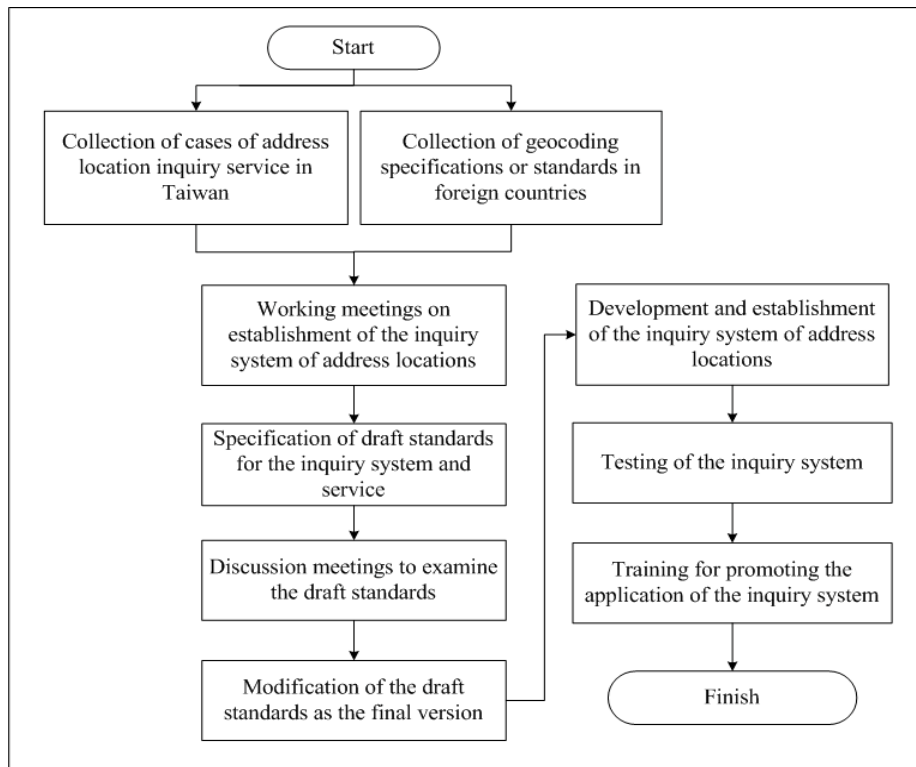
MOI has set up the TGOS, an Internet-based one-stop portal and mechanism for sharing integrated geospatial data and geographic information which were originally geospatial databases set up by the government sector and private organizations mainly for own use. In order to enhance the application of the address databases and functions of TGOS, MOI started to establish a national system for inquiry on coordinate values of spatial locations of such building addresses through SOA-based geocoding of addresses around Taiwan in 2009.

The inquiry system of address locations is in a two-level structure, that is, application systems (users of the inquiry service) access the inquiry service component of TGOS at the first level and then, after TGOS 4A module (Authentication, Authorization, Accounting and Auditing) certification, are connected to the server and database for a county or city (recognized by the parameters of calls for the service) at the second level to obtain the locational coordinate values of the target addresses. The website of the inquiry system of address locations: <http://ngisdata.moi.gov.tw/>.

2. Working Process

The establishment of the inquiry system of address locations and the subsequent promotion of its application involves collaboration between the central government and local governments, with the process of implementation is shown in Diagram 1 and stated as follows:

Diagram 1: The Process of Establishing the Inquiry System of Address Locations



(1) Collection of literature:

Collection of cases of inquiry service for locations of addresses in Taiwan as well as specifications or standards related to geocoding used in foreign countries.

(2) Working meetings:

Interviews with government units which will use the inquiry system so as to understand their demand; conferring with units in charge of address databases under local governments; holding a national conference to explain the inquiry system and the work of setting up the system as well as local governments' responsibilities in the work; inspecting 25 local governments' existing address databases to see how they could be used in the inquiry system to avoid duplication of efforts to set up databases.

(3) Specification of draft standards for the inquiry system

Service based on the results of (1) and (2); discussion of the draft standards at the aforementioned national conference or subsequent working meetings to finalize them.

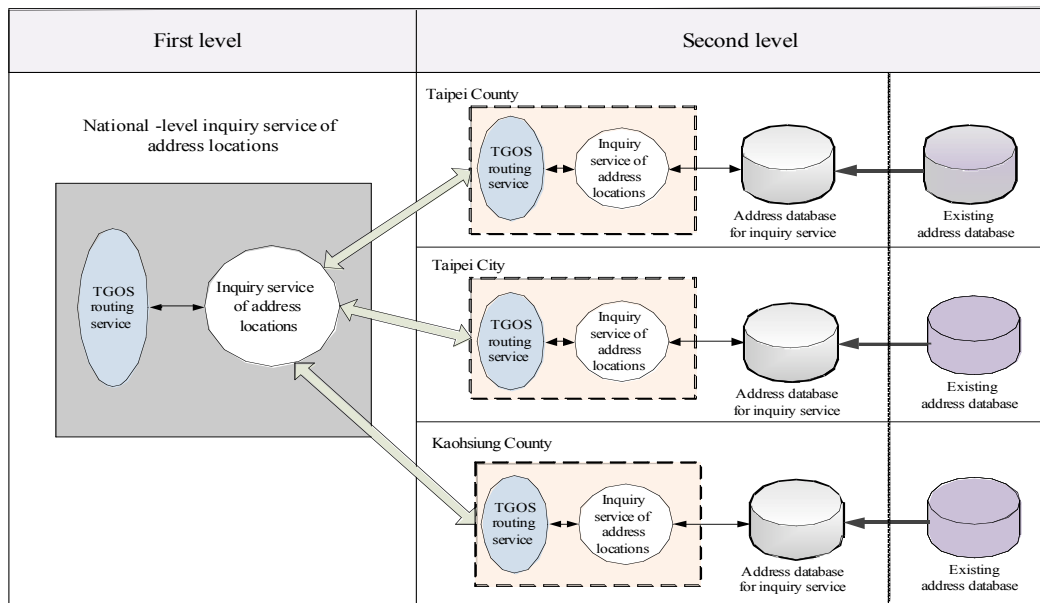
(4) Development of service components for the inquiry system

Design, development and testing of necessary service components based on the standards determined in (3); holding meetings to explain the service components to local governments' staff members responsible for address administration and information management for administration as well as consulting companies participating in the work; each local government then gets existing databases ready for use, sets up a server system, installs service components in the system and makes set-up, tests the system, starts operation of the system and regular maintenance; after local governments complete the establishment of their server systems (the second level) and begin operation, MOI has its server system (the first level) connected to each local government's system to finish the establishment of the inquiry system of address locations.

3. The Structure of the Inquiry System of Address Locations

The inquiry system of address locations is in a two-level structure as shown in Diagram 2.

Diagram 2: The Structure of the Inquiry System of Address Locations



The operation of the system: application systems (users of the inquiry service) access the inquiry service component of TGOS at the first level and then, after TGOS 4A module (Authentication, Authorization, Accounting and Auditing) certification, are connected to the server and database for a county or city

(recognized by the parameters of calls for the service) at the second level to obtain the locational (X, Y) coordinate values of the target addresses.

There are seven coordinate systems available for choice in the inquiry system of address locations: EPSG:3821 (TWD67 /LL zone 121); EPSG:3824 (TWD97 /LL zone 121); EPSG:3825 (TWD97 / TM2 zone 119); EPSG:3826 (TWD97 / TM2 zone 121); EPSG:3827 (TWD67 / TM2 zone 119); EPSG:3828 (TWD67 / TM2 zone 121); EPSG:4326 (WGS84).

The structure consists of three key parts, namely, (1) local governments' establishment of their address databases; (2) framework of local governments' inquiry service of address locations; (3) service components of the inquiry system.

4. Establishment of Address Databases by Local Governments

In order to be standardized and consistent, local governments' existing address data files imported into address databases specifically for use in the inquiry system should be in the format of either CSV (comma-separated values, as shown in Table 1), adopted by MOI for numbers and text of addresses, or spatial data standards for addresses in GML (geography markup language, as shown in Diagram 3).

Table 1: Fields of MOI's Address Data Files

Category of information	Data
Administrative unit	City or county
	Precinct under city, town or rural township under county
	Neighborhood in an urban area (Li) or village in a rural area
	Subdivision of a neighborhood or a village (Lin)
Address	Road and its section, street
	District
	Lane
	Alley
Coordinate	Number
	Abscissa
	Ordinate

Diagram 3: An Example of Spatial Data Standards of Addresses in GML

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<gml:featureMember>
  <ADDR_address>
    <spatial location>
      <gml:Point srsName="urn:ngis:crs:TWD67TM2">
        <gml:coordinates>

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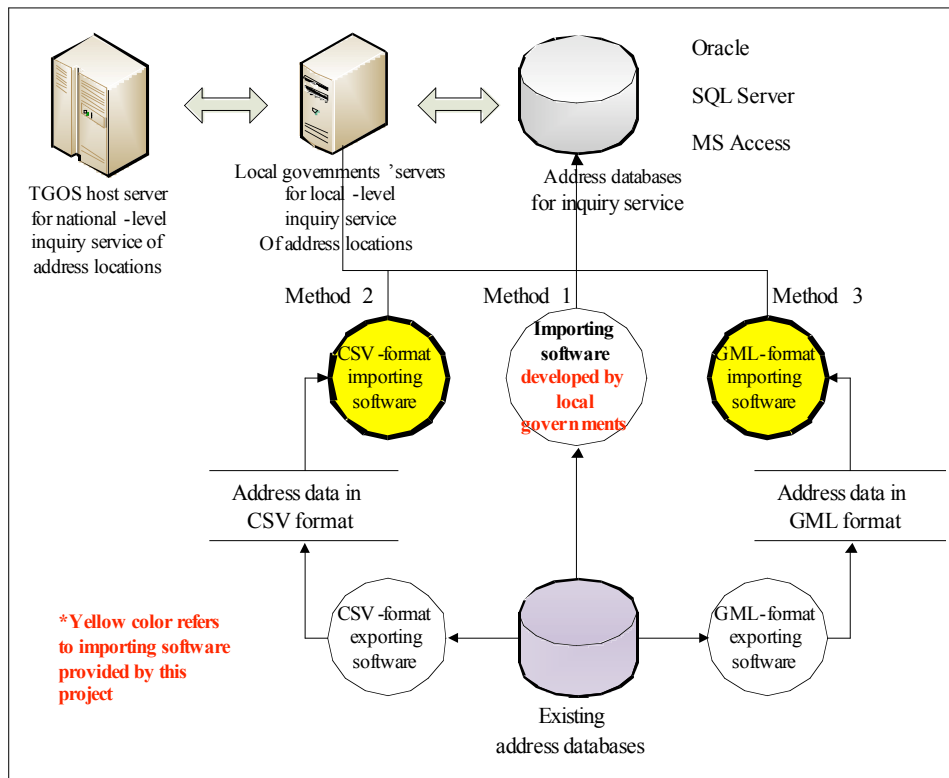
```

168731.270,2544151.100
  </gml:coordinates>
</gml:Point>
</spatial location>
<address>13, Lane 141, Yu-lo Street, Lin 023, Chen-da Li, East
Precinct, Tainan City </address>
<city or county>Tainan City</city or county>
<precinct or town or rural township>East Precinct</ precinct or town or
rural township >
<li or village>Chen-da Li</li or village>
<lin>Lin 023</lin>
<road and section, street>Yu-lo Street</road and section, street>
<lane>Lane 141</lane>
<number>13</number>
<time>
  <gml:TimeInstant>
    <gml:timePosition >2005-05-01</gml:timePosition>
  </gml:TimeInstant>
</time>
<time indicator>01</time indicator>
<space of indicator>03</space of indicator>
</ADDR_address>
</gml:featureMember>

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Diagram 4 shows the process of local governments' establishing their address databases:

Diagram 4: Framework of Local Governments' Establishing Address Databases



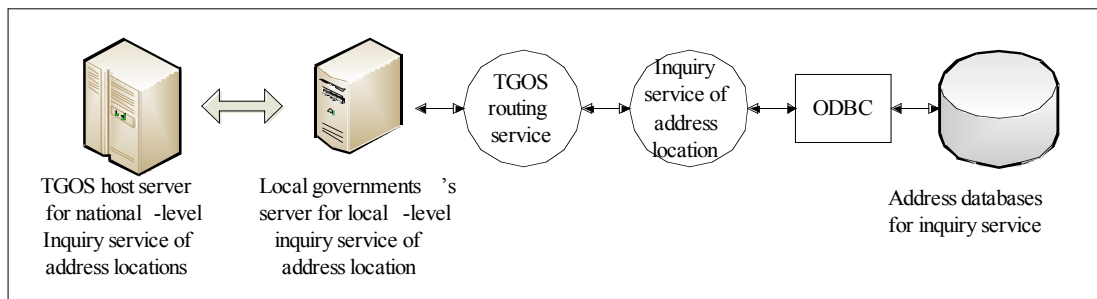
(1) Readiness: A local government, based on its hardware and software environment (Oracle, SQL Server, Microsoft Access, etc.), opens accounts and specifies tables of data for its address database specifically for use in the inquiry system.

(2) Import of existing address data: The local government sets up ODBC (open database connectivity) and connects it with its address database, and then imports existing address data into the address database in CSV, GML or a self-developed format.

5. The Framework of Local Governments' Inquiry Service of Address Locations

A local government's system for inquiry on locations of addresses consists of two service components, as shown in Diagram 5. One service component is to provide the location of a target address based on SOAP (simple object access protocol) web service generally, the other is TGOS routing service which accepts the inquiry service calls meeting TGOS access requirements, and then route the calls to the former service component for it to access address databases through ODBC.

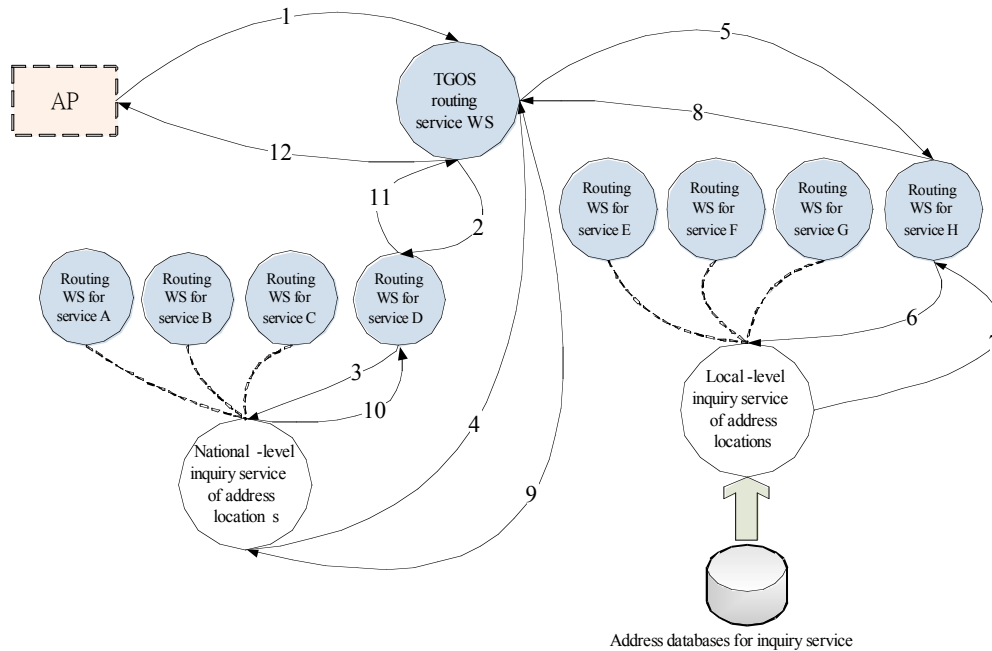
Diagram 5: Framework of Local Governments' Inquiry Service of Address Locations



6. The Operation of the Inquiry System of Address Locations

The TGOS routing service is to receive calls from Application ID (AP, users of inquiry service), control calls for authorization to use the service and then transfer the qualified calls to Service ID (providers of locations of addresses). Because only authorized AP can use the inquiry service, the TGOS routing service component performs the function of authenticating AP between TGOS platform and Service ID, as shown in Diagram 6 and explained as follows.

Diagram 6: Operational Relation between TGOS Routing Service and the Inquiry System of Address Locations



(1) Routing WS (web service) for Service A~H

They are service components in compliance with TGOS access requirements mainly for checking whether inquiry service calls are from TGOS routing service and, through verifying AP's Security Token for authorization, transferring the authenticated calls to a local government's inquiry service component to access needed locations of addresses.

(2) Inquiry service of address locations at national level (around Taiwan) is of the following four inquiry formats:

- #1 Single address in string (National SingleAddrStrQuery)
- #2 Single address in field (National SingleAddrFieldQuery)
- #3 Multiple addresses in string (National MultipleAddrStrQuery)
- #4 Multiple addresses in filed (National MultipleAddrFieldQuery)

(3) Inquiry service of address locations at local level (around a city or a county) is of the following four inquiry formats:

- #1 Single address in string (County SingleAddrStrQuery)
- #2 Single address in field (County SingleAddrFieldQuery)
- #3 Multiple addresses in string (County MultipleAddrStrQuery)
- #4 Multiple addresses in filed (County MultipleAddrFieldQuery)

(4) Local governments' routing service components (Routing WS for Service E~H) respectively correspond to the national-level routing service components (Routing WS for Service A~D). D and H, for example, respectively represent TGOS national-level inquiry about multiple addresses in field (TGOS National MultipleAddrFieldQuery) and TGOS local-level (city or county) inquiry about multiple addresses in field (TGOS County MultipleAddrFieldQuery). Following is explanation of the operation shown in Diagram 6:

- Step1. [AP] calls [TGOS Routing Service WS] and inputs APToken0 (AP's authentication code), AID0 (AP's registration code), SID1 (Service ID's registration code) and address data;
- Step2. [TGOS Routing Service WS] checks AID0 and SID1 and then transfers the call to [Routing WS for Service D] along with input of authorization Token and address data;
- Step3. [Routing WS for Service D] checks the authorization Token and then calls the [National-level Inquiry Service of Address Locations] along with transfer of the address data;
- Step4. [National-level Inquiry Service of Address Locations] recognizes the cities/counties in which the addresses are located and then uses another registration code AID1 to access [Routing WS for Service H] via [TGOS Routing Service WS] to transfer APToken1, AID1, SID2 and the address data to the latter;
- Step5. The same as in Step 2, but the target of call is [Routing WS for Service H];
- Step6. The same as in Step 3, but the target of call is [Local-level Inquiry Service of Address Locations];
- Step7~12. The entire process of transferring and checking up (X,Y) coordinate values for the locations of the addresses in response to the call from [AP].

7. Problems and Solutions

As the establishment of the inquiry system of address locations and the subsequent promotion of its application involves collaboration between the central government and local governments, MOI held working meetings to explain the establishment to staffs of local governments and have them adjust existing address databases for as much use in the establishment as possible and then trained the staffs specifically for carrying out the establishment.

Since some of the existing address data do not conform to the standard formats of addresses for the inquiry system, the aforementioned adjustment focuses on the process of importing existing address data into the address databases for use in the inquiry system. Based on problems found by local governments in testing CSV importing of existing address data, the process and rules for importing were modified and software programs were adjusted to tolerate data errors in an attempt to make the existing data not meeting standard formats still usable for the inquiry system.

After the staff training, there were many cases of failure in installing service components due to problems in setting up networking, operating systems, ODBC, etc. While the establishment involves 25 cities or counties, the team responsible for developing the inquiry system helped each local government's staff solve various problems by using diverse methods including LOG and PATCH files.

8. Conclusion

After the inquiry system of address locations is completed, developers of application systems for various government agencies do not need to collect and process address data to find out coordinates of address locations for specific administrative purposes. In addition, users can obtain real-time and complete data on locations of addresses from widely distributed local-level platforms through the national-level inquiry system of address locations, an Internet-based one-stop portal and mechanism for sharing geospatial data and minimizing duplication of efforts to set up databases.

The two-level structure demonstrates two characteristics essential to promoting the application of the inquiry system: One is to simplify operating procedures for the application through integrating geographically distributed resources (local governments' address databases) and service (local governments' inquiry service of address locations) into a single platform for one-stop service; the other is the importance of standards for data exchange because the specification of formats for address data exchange facilitates the integration of address data across cities and counties and is crucial to the success of establishing the inquiry system.

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