

1. Introduction

At Metropolitan Government offices, 1,500 expert staff members formulate and implement city planning measures and policies. In order to carry out city planning activities efficiently, we compiled a geographical information system (GIS) database on the use of 1,800 km² of land and the use, number of stories and structure of approximately two million buildings. Moreover, many of these staff members wanted to enjoy the benefits of GIS which, to give an example, enables the entire staff to get a handle on the current state of an area where a city plan is scheduled to be executed or prepare materials to put a city plan into practice.

The existing system had been designed for use by only some staff members specializing in GIS. However, there was no GIS system available, which was accessible to anyone on the staff.

Against this backdrop, the Metropolitan Government developed a large-scale Web system using ArcGIS Server in order to help staff conduct city planning activities.

In this report we will outline the system which was developed based on user requirements, the problems encountered and their solutions and the future direction for the system.

2. System development

2.1 System development requirements

The user requirement was to give shape to a high-functioning GIS on the Web. In other words, the requirement was tantamount to making ArcMap available on the Web.

In addition, the security level of the user's network was extremely high. Not a single plug-in (ex. Active X, JavaApplet) was allowed under security rules. We thus had to realize a system through HTML alone.

As well, the amount of data handled by the system was staggering; map data alone amounted to several gigabytes. The number of clients with access was 1,500 and the number of clients that could access simultaneously was roughly 50.

On top of these requirements, the allowed system development time was not to be more than three months to first release. To meet all these requirements, the option available to us was nothing other than the ArcGIS Server. We took up the challenge to meet the toughest conditions with the best possible tool.

2.2 System overview

We set about developing the system in March 2005. We released the basic functions only on June 1, 2005 and released all the remaining functions in January 2006. Let us

take a moment to introduce the system configuration in part and the functions that we built into it. Diagram 1 shows the system configuration.

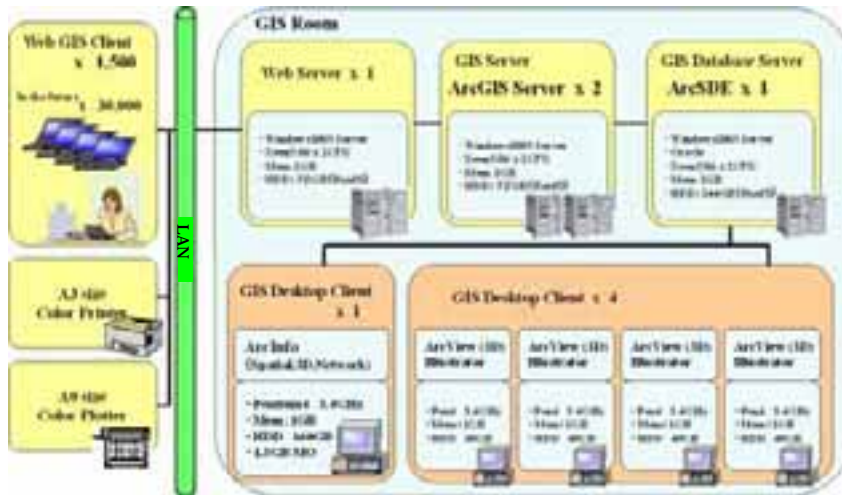


Diagram 1 System configuration



Diagram 2 System's GUI

Diagram 2 shows the functions of the implemented system. It is GUI looking as if it were ArcMap.

An editing function is incorporated into this system, allowing a new layer to be added.

By making use of a new polygon added by the user, data on buildings is chosen to tally up attributes. This is used to understand the current status of existing buildings, such as their use, when the administration studies an area to be redeveloped, for instance.



The screen image shown in Diagram-3 is an address matching function. If the user has an address book in CSV form, it is possible to carry out address matching and add a new point layer. The system can compile data on applications filed for development approval and the locations for which construction applications have been filed.

Diagram-3 Address matching function



The image shown in Diagram-4 represents a print function.

To study city planning measures and policies and prepare presentation materials for the press, a print function that allows free layouts is needed.

This system meets various printing needs thanks to the number of templates available. It can handle PDF and image file output among others.

Diagram-4 Print function

3. Problems arising in the system and their solutions

We ran into a wide variety of problems at the time of the first release. We also found additional problems with the system that began operating three months later. Let us share with you these problems and their solutions.

3.1 Problems encountered

The problems we faced in developing and operating the system included:

- (1) When more than one user simultaneously accessed the system, the server's resources were exhausted, resulting in limiting access to a smaller number of users by far than we had expected.
- (2) At the time of computer booting or TOC operation, response for shifting to a layout was extremely poor.
- (3) The work data needed to be saved.
- (4) All the functions needed to be realized through HTML alone.

3.2 Solutions

The following are solutions to the aforementioned problems:

- (1) We prepared two types of applications, i.e., viewing and editing versions.

When the editing function was not being used, we made sure that the user was guided to making use of the application for viewing; thereby reducing the burden on the server and increasing the number of accesses.

No miraculous breakthrough to address this problem can be expected.

We added memory modules to the servers. The burden on the Web server in

particular proved greater than we had expected.

- DB server memory 2 4GB
- Web server memory 1 4GB

Programming to allow a single session to unify the number of SDE connections with an eye on reducing load and steady by-the-book tuning of Oracle/ArcSDE are specific solutions, but having staff understand manners for sharing common resources, through a workshop, was an equally important solution.

(2) We invited an engineer from the head office of ESRI in the United States to check the customer's environment and we consulted with him about how to improve response.

He provided us with a basic idea to change the layout and improve TOC. Changing TOC from a sample-based, consecutive renewal-type operation to an operation method by which the map screen is renewed after making more than one change by pressing a button proved effective in lightening overall operations.

Tuning the DB as mentioned above helped improve the speed for displaying Map.

(3) The saving of user data was made possible by SDE's versioning function. Map extent or display layer information (saving of projects) was realized by storing them into SDE's BLOB.

This made it possible to avoid the delicate part of creating a new table on Oracle each time.

Furthermore, we were able to prevent performance from deteriorating as the number of records rises in the case in which everything is configured by a single table.

(4) We selected the ArcGIS Server and configured GUI with HTML and JavaScript alone, meeting all requirements with basic operations of the ArcGIS Server as is.

There are quite a few poor, older machines among the 1,500 client machines, but with no additional installations, they compare favorably with the latest equipment, operating with absolutely no problem.

4. Conclusion

The Metropolitan Government developed a large-scale Web system using the ArcGIS Server. One year has passed since it began operating and the number of users has been rising little by little. At present, dozens of users access the system each day and the system's response is satisfactory. Not a single problem has arisen since it was put into operation.

Users who previously had to wait their turn to make use of the existing system, AcView, are now able to use GIS with the machine they have at hand at any given time. A result of developing an easy-to-use GIS system has been that users' GIS technical skills

have improved. Consequently requests for preparing data to gain an understanding of various situations or for consultation about city planning have been on the rise.

We will continually hold workshops to teach novice GIS users how to use the system and offer consulting services to formulate a city plan, so that as many members on the staff may be able to fully utilize the system as possible. Moreover, we aim to develop and deploy the next-generation GIS system that will allow easier use of three-dimensional data.

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