Research and Application on the Exchange and Management of the Spatial Data on Networks

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Abstract : The rapid developments of the application of GISs and computer networks makes it possible to digitize and store geo-spatial data distributedly. In order to fit for the demands of information integrated application based on networks, people have paid great attention to the exchange and management of spatial data on networks. In this paper, we analyzed the model of distributed information service and its basic characters, and proposed the basic model and the data processing methods of exchange and management of spatial data on networks such as data format conversion , projection transforming， and positional match of different spatial data. Besides, as an application example of the spatial data exchange and management technology, the implementation situation of the thematic spatial data exchange and management in the Flood Control Information Service System is introduced.
Keywords: Spatial data, Networks, Data exchange, Data management.

INTRODUCTION

The rapid developments of computer, computer server and networks create a favorable hardware environment for distributed data computing and processing. The increasing business data begin transferring through networks. More and more general users begin using networks except professional experts. However, different data should be transferred and used in order to satisfy different applications, and they usually can be typed into one of four categories: voice, data, image, and video. Increasing data on networks also accelerate the development of high-speed and broadband networks products. Wide-Area Networks, Local Area Networks, and Wireless networks will connect together, and transfer information for communication outside the office. So, networks are becoming increasingly popular both public agencies and private families[4][5].

Because most of data used for different applications are related with spatial position, so the spatial data displaying, accessing, querying and more complicated GISs application on networks will become important trends of GISs in the future [1,2,3].

In this paper, we analyzed distributed information service and its basic characters. On the other hand, we proposed the basic model and the data processing methods of exchange and management of the spatial data on networks. Next, as an application example of the spatial data exchange and management technology on networks, the spatial data exchange and management in the Flood Control Information Service System is introduced.

The model of distributed information service and its basic characters

Client-Server Architecture for GIS Application

The technical development and cooperative computing lead to distributed data processing. The GIS applications on networks also can be distinguished into applications on clients and applications on servers just liking applications of common business data based on networks. Of course, the basic software is an operating system both clients and servers. The platforms and the operating systems of clients and servers may differ. In order to support the same GIS applications, clients and servers need share the same communication protocols[4,5](Fig.1)

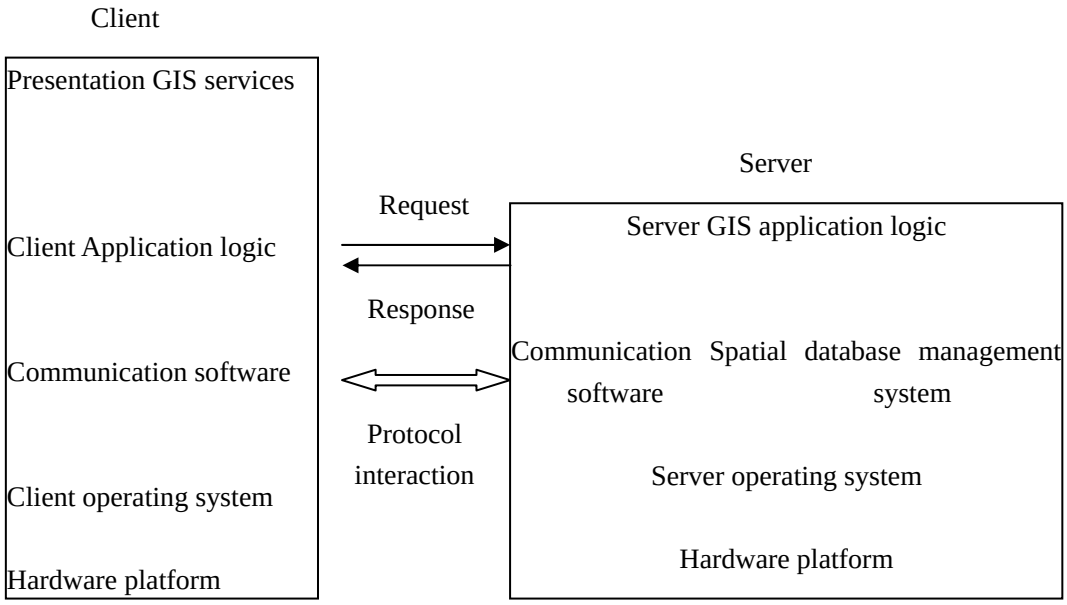

Figure 1 Client-Server Architecture for GIS Application

According the allocation of functions between clients and servers, the GIS applications can be classified into four types : host-based GIS application, server-based GIS application, cooperative GIS application, and client-based GIS application. In host-based GIS application, all of the data management and processing is done on a central host. In server-based GIS application, all of the processing is done on the server, while the client only provides a graphical user interface. In cooperative GIS application, the application processing takes advantage of the strengths of both client and server machines and of the distribution of data. In client-based GIS application, all application processing may be done at the client except logic functions that are best performed at the

server.

Basic characters of distributed GIS application

There are many advantages to use networks, but the following characters are special to distributed GIS application:

- Because the distributed GIS application can provide different users with sharing spatial information by networks, so it can enlarge the service range of GIS, and change application model. Under networks environment, GIS application will be expanded to cross-department, cross-region, and cross-profession information service, even can serve for all of society.
- The data security will be improved by strict data controlling and accessing on networks.
- The suitable allocation of GIS functions among servers and clients may simplify operation, and satisfy different requirements of multi-level users.
- The distributed GIS application can make all programs, equipment, and especially spatial data available to anyone on networks without regard to the location of the data and user. It not only will balance and make the best of computing resource and space, but also can implement resource sharing and saving money.

The basic model and methods of the Exchange and Management of the Spatial Data on Networks

The rapid development and popularization of spatial information services on networks have put forward some new requirements to the exchange and management of the spatial data on networks. There are wide variety of GIS applications, each with its own data types including vector data, raster data, table data, and multi-media data. The High-speed data transmission and different spatial data exchange and management methods are needed for different applications.

The basic model of the Exchange and Management of the Spatial Data on Networks

According to the development of network GIS in the future, the data distributed storing and distributed computing will become important trends. Different Spatial data always distribute on different computers that connect together through networks. The spatial data exchange and management may be finished cooperatively by several GIS servers[6]. In order to improve system operation speed and simply data management, it is necessary to create the basic spatial database on application server and process the dynamic spatial data on database server. The static thematic spatial data will be integrated on application server by interactive data processing and connecting with basic spatial data. According practical operation demands, the dynamic thematic spatial data will be searched and processed on database server automatically, and finally be packed and transformed to application server for real-time loading(Fig.2).

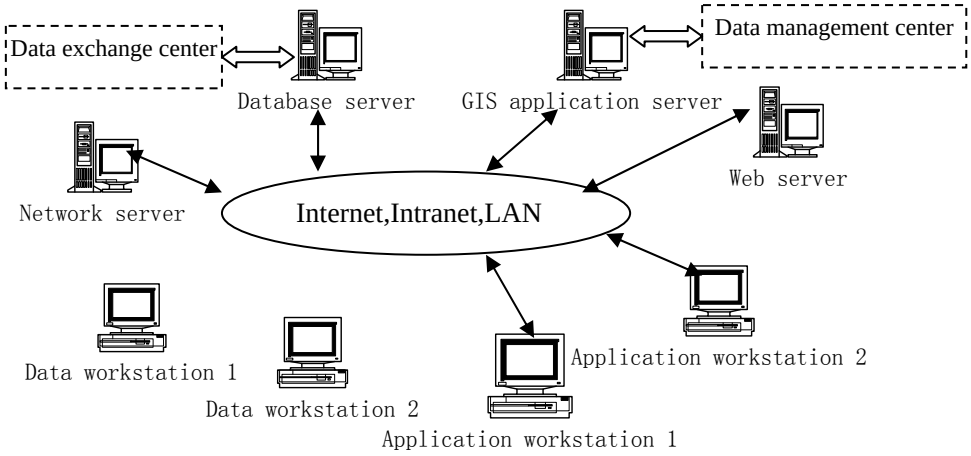

Fig.2 The basic model of the Exchange and Management of the Spatial Data on Networks

Spatial data Management

The management of spatial data may select different models in different application phases. In order to meet data updating and maintaining separately and follow the advances of RDBMS and Client-server technologies, the mixed data management model should be selected for spatial data management on networks. The relationships among spatial data can be stored and managed in RDBMS. Spatial data are composed of index tables and four basic objects (point, line, polygon, and complex object) which are stored data files and managed with topological structure. Based on spatial data, to connect comprehensive non-spatial data with spatial data by creating relation tables, according to different applications.

Data processing basic methods

All of the data should be processed according common methods so that data distributed on different computers can be used integratedly for showing, querying and analyzing for different themes. The data processing basic methods include data format converting, adjusting for coding system projection transforming, coordinate and attribute matching, creating index table, and display way setting etc. As for dynamic data, we need create a data dynamic exchange template which defines dynamic data searching, processing, storing and loading parameters(Fig.3).

The implementation of the technology of exchange and management of spatial data in the Flood Control Information Service System

The occurrence frequency of flood disaster in china is higher than the world average .So integration application of Geographic Information System(GIS) can play an important role for reducing the damage. In order to provide decision-makers with disaster information quickly, it is

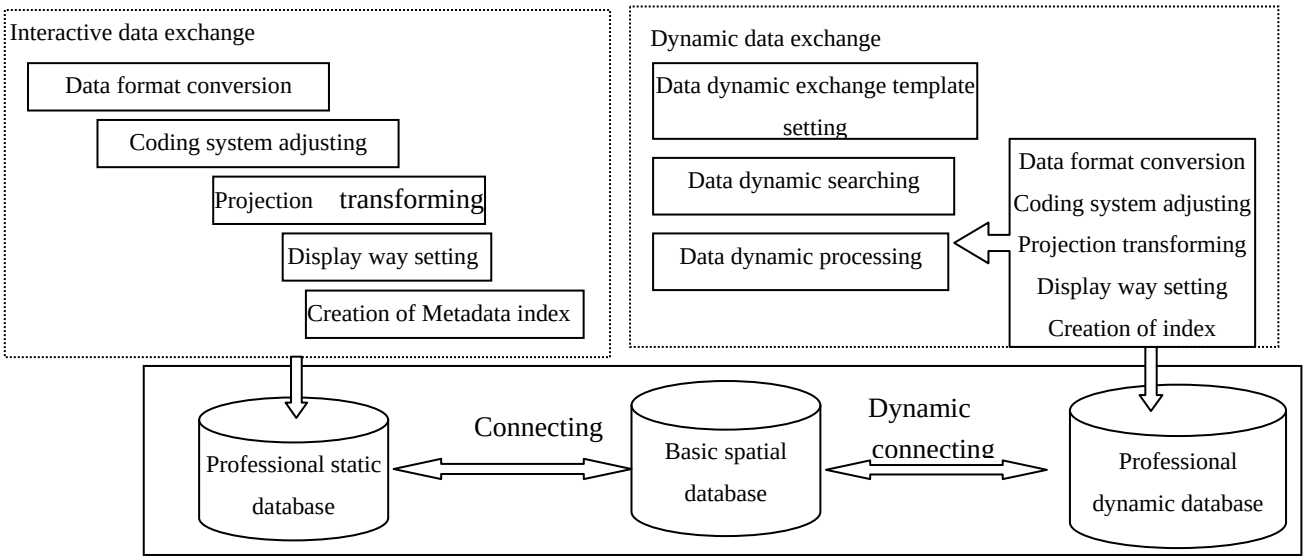

Fig.3 Data processing basic methods

necessary to send ,access and manage data through networks . Data related to flood control are various according to requirements of flood control information service, among them include the distribution of the major hydrographic station and hydrological data, the distribution of seven river basins and main rivers, the large reservoir data, the rainfall and its forecast, the satellite image of cloud and its animation, the typhoon moving path and its forecast, the remote sensing information of disaster situation and basic geographic data (e.g. boundary, road, railway, river and canal, lake and reservoir ,terrain, and settlement etc.)[7]

Because professional flood data come from different departments, so the data standard each department used is not common.. In order to display, query and analyze comprehensive data integratedly, all data related to flood control should be managed unifiedly. As to some often unchanged data, they should be integrated to unique basic spatial database through interactive methods including data format conversion, projection transforming, loading and attribute connecting with spatial data. As to some often changed data(e.g. hydrographic station data, rainfall and its forecast etc.), the system must load, link and update them dynamically, so that the system has high efficiency(Fig.4)

Conclusion

The storage and management of spatial data on distributed environment has become one of important problems alone with development of spatial data application on networks. In this paper, based on analyzing the model of distributed spatial information service and its basic characters, we presented the model for spatial data exchange and management on networks, and introduced the main implement technologies related to data processing and management. Next, as a feasibility of the mentioned technologies, we implemented different professional data exchange and management in the Flood Control Information Service System, and provided government leaders with

information services by information displaying, querying, comparing, and analyzing intergratedly.

According implementation, we suggest following problems should be discussed in future:

- Safety precautions of data exchange and management on networks
- How to improve running speed after spatial data stored in RDMS
- Checking methods for integrated data consistency

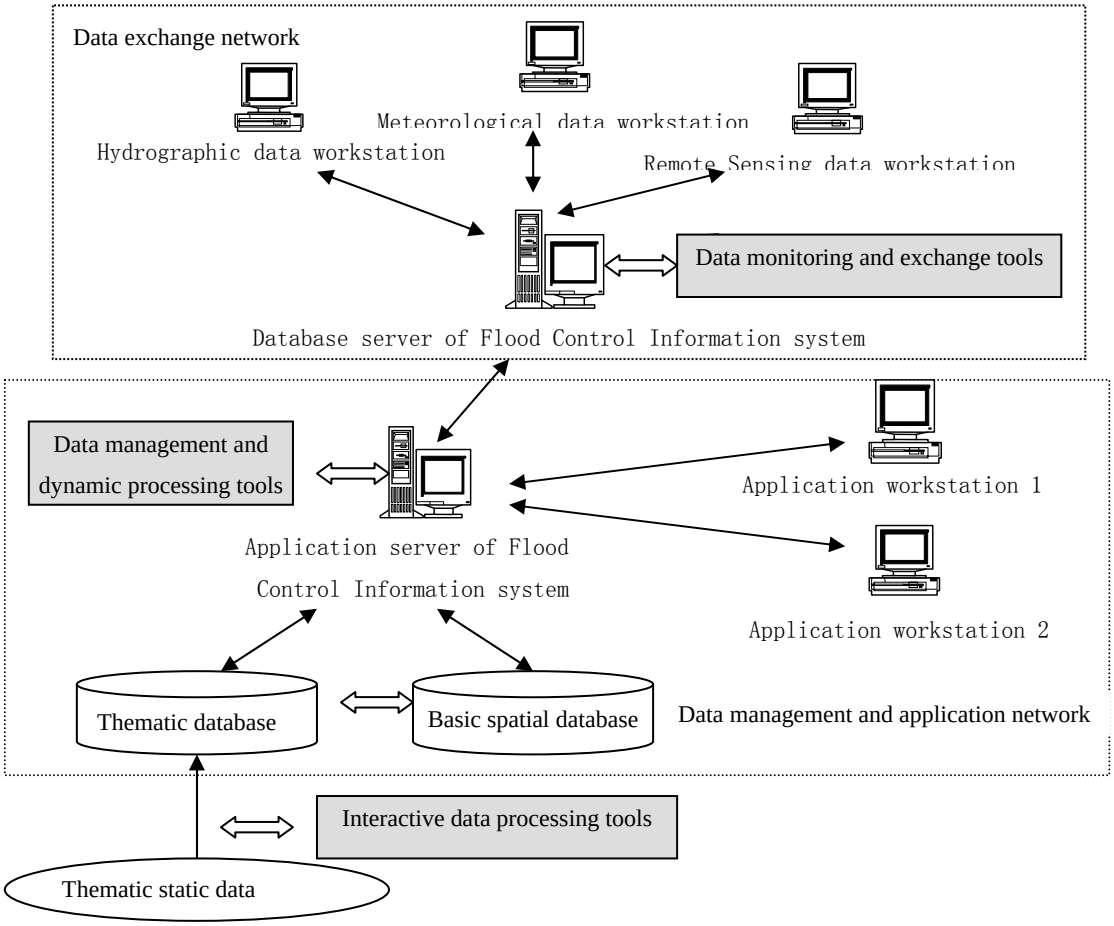

Fig.4 The data Exchange and Management of Flood Control Information System

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