STUDY AND IMPLEMENTATION ON MASS SPATIAL DATA MANAGEMENT BASED ON LARGE DBMS

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ABSTRACT:

This paper discusses the technology about mass spatial data management based on large business DBMS.It introduces and contrasts the spatial management mode of ESRI SDE and ORACLE Spatial. This paper also gives independent view about the application of spatial data management on DBMS in GIS system,and gives application system demostration based on ESRI SDE and ORACLE Spatial.

KEY WORDS: ORACLE Spatial,Spatial Database Engine,ORDBMS,ADT

1.INTRODUCTION

Digital city is composed of mass spatial data.The management on spatial data depends on two technologies:one is mass storage,the other is spatial database. With the development of electronic technology,multi-CPU high performance server and GB level raid hard disk make mass storage realizable.But because of speciality of spatial data,traditional DBMS is challenged on spatial data management.Then,study on mass spatial data management is needed.

This paper discusses the technology about mass spatial data management based on large business DBMS.It introduces and contrasts the spatial management mode of ESRI SDE and ORACLE Spatial. This paper also gives independent view about the application of spatial data management on DBMS in GIS system,and gives application system demostration based on ESRI SDE and ORACLE Spatial.

2.THE FEATURES OF MASS SPATIAL DATA MANAGEMENT BASED ON LARGE DBMS

Firstly,managing spatial data by DBMS can realize distribute spatial data processing and concurrency.Digital city is a large spatial database system,many clients often access spatial data at the same time. Secondly,because of frequent change of spatial data ,version control on spatial data entity can be added by DBMS.Thirdly, after spatial data is imported into database,all data has the same data structure.In this way,system's interoperation will be improved greatly.Next, DBMS has mass data storage capacity itself.Through optimized organization pattern, mass spatial data can be managed effiently.And through database,raster data,vector data ,DEM data,metadata and ordinary business table can be organized.It's useful for fusion and analysis of multi-source data.

Nowadays,management on spatial data has been taken into account by large DBMS vendors,there're two main schemas about spatial database:

2.1 SPATIAL DATABASE ENGINE BASED ON MIDDLE WARE TECHNOLOGY

SDE(Spatial Data Engine)is a middle ware between database server and application system. SDE substantially provides an interface for heterogeneous data entering into heterogeneous database.SDE provide a kind of standard multi-users and distribute spatial data management pattern,which takes place of traditional spatial data management pattern.SDE stored spatial data based on relational database.In this way, spatial data's relational storage can be realized by a group of associated feature tables,attribute tables and index tables. The data integrity of spatial and non-spatial data can be maintained by DBMS mechanism such as trigger and constraint,etc.For example,ESRI SDE provide tools for ESRI shape file and coverage imported into DBMS.ESRI also provides application program interface and embedded spatial query algorithms in order to integrate GIS software and large DBMS.

2.2 SPATIAL DATA OBJECT BASED ON ORDBMS MODEL

Object-Relational Database Management(ORDBMS) has become a new standard,which adapts to the requirement of managing multimedia data and spatial information. MapInfo SpatialWare is the first spatial information management system based on SQL in ORDBMS environment.It can perform spatial analysis and spatial query.ORACLE provides spatial data management tool from version8.0.4----Spatial Catridge.Now,oracle's spatial option is based on ORDBMS model.It provides a kind of spatial data model----SDO (Spatial Data Object).SDO contains four parts:

1) A kind of pattern storaging spatial data oject
2) A kind of spatial data index mechanism
3) A group of algorithms and functions for querying spatial data
4) A group of tools for managing spatial data

3. CONTRAST BETWEEN ESRI SDE AND ORACLE SPATIAL

The purpose of ORACLE Spatial and SDE is to realize management and application on mass spatial data based on large DBMS. But there're obviouse differences between them,including:

Firstly,ESRI SDE is a middle ware in contrast with DBMS.SDE hides the difference of data model,physical implementation among different database platforms. SDE support many DBMS,including ORACLE,SQL Server,DB2,Infomix,etc.SDE realized the spatial data management and application professionally and independently.SDE can manage not only simple features such as point,line,area,but also object-oriented annotation,line topology,area topology,raster data,CAD data,etc.And at the same time,work flow based on version control management and long transaction processing mechanism is supported.ORALCE spatial's SDO is integrated with DBMS,which is one of options of DBMS.

Secondly,as far as spatial data physical model,SDE is based on traditional DBMS.Because of not supporting spatial data type,the role of SDE is to realize spatial data storage and analysis.At the same time,spatial data is stored using basic data types such as number,binary,and realize spatial storage through a group of relational tables.See Fig1.

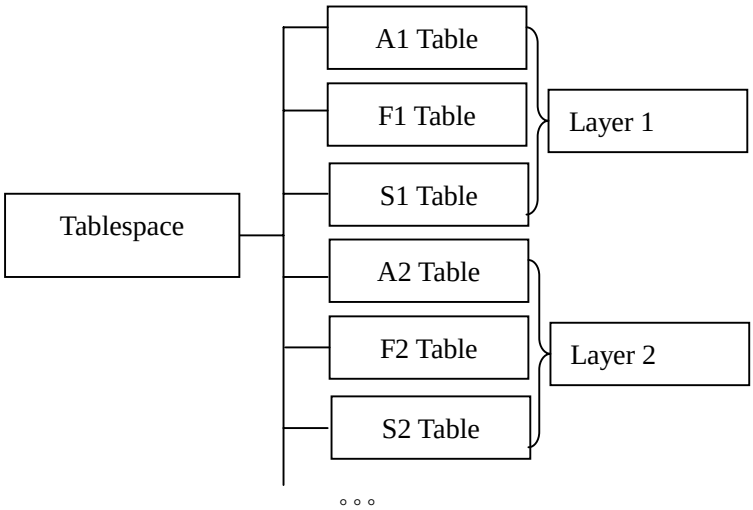


Fig 1. SDE's Data Structure

Oracle spatial extended spatial data model on the basis of object relational database.The data model of ORACLE spatial is a hierachical structure composed of elements,geometries and levels.It supports OGC spatial data type and constructs spatial data type SDO_GEOMETRY,which is a container storing point,line,areas and collections.The attributes of SDO_GEOMETRY see Fig2.

```
CREATE TYPE SDO_GEOMETRY
AS OBJECT（
SDO_GTYPE    NUMBER，
SDO_SRID      NUMBER，
SDO_POINT     SDO_POINT_TYPE，
SDO_ELEM_INFO
MDSYS.SDO_ELEM_INFO_ARRAY,
SDO_ORDINATES
MDSYS.SDO_ORDINATE_ARRAY)
```

Fig 2. Attributes of Oracle Spatial SDO

Thirdly,as far as the access pattern of spatial data concerned,ORACLE spatial provides completely open structure for accessing spatial data.ORACLE spatial integrates spatial data engine and sql engine closely in server side.It adopts white box,that is the content of data object can be accessed and manipulated directly.The benefit of white box is that user can access data through SQL directly.So,more and more GIS vendors use ORACLE spatial directly in their spatial

data management.In this way, some problems of the integrity of data may be brought up.SDE adopts black box.The client side can't manipulate the content of data stored in feature tables.Instead,client can only access spatial data in middle ware level.

Fourthly,considering application program interface,SDE provides efficient,consistent spatial query interface for users in application server level.And the query interface is the basis of spatial analysis and spatial data mining.SDE functions are embedded in softwares such as ARC/INFO,ARCVIEW,MAPOBJECTS.These softwares can access SDE as client side.SDE provides SDE C API for the third party developers in order to realize SDE function invoktion. In this way,all spatial data access and analysis is finished in client side.See Fig3.

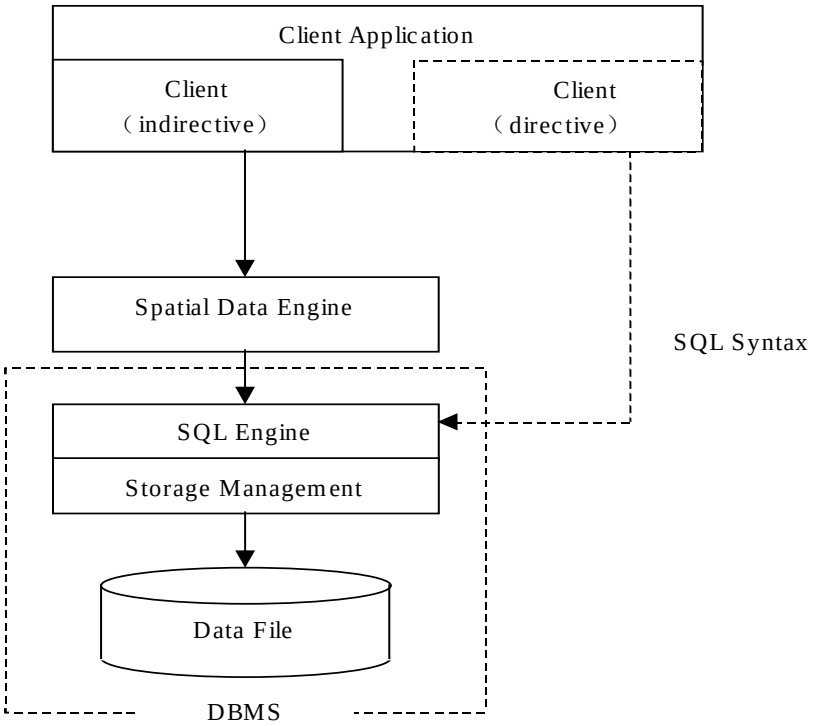


Fig 3. SDE's Software Architecture

Oracle spatial define Abstract Data Type(ADT) in DBMS based on extensible DBMS(ORDBMS).It adds spatial data type making use of DBMS's capacity.It provides many SDO_GEOMETRY functions,which realize the integratation between spatial data type and functions in database servers.In this way,it moves spatial functions from application server tier to database server tier.Then,it is not necessary for developers programing using special API.Developers can define and manipulate spatial data through SQL.So,developers can access spatial data independent of GIS product platform.See Fig4.

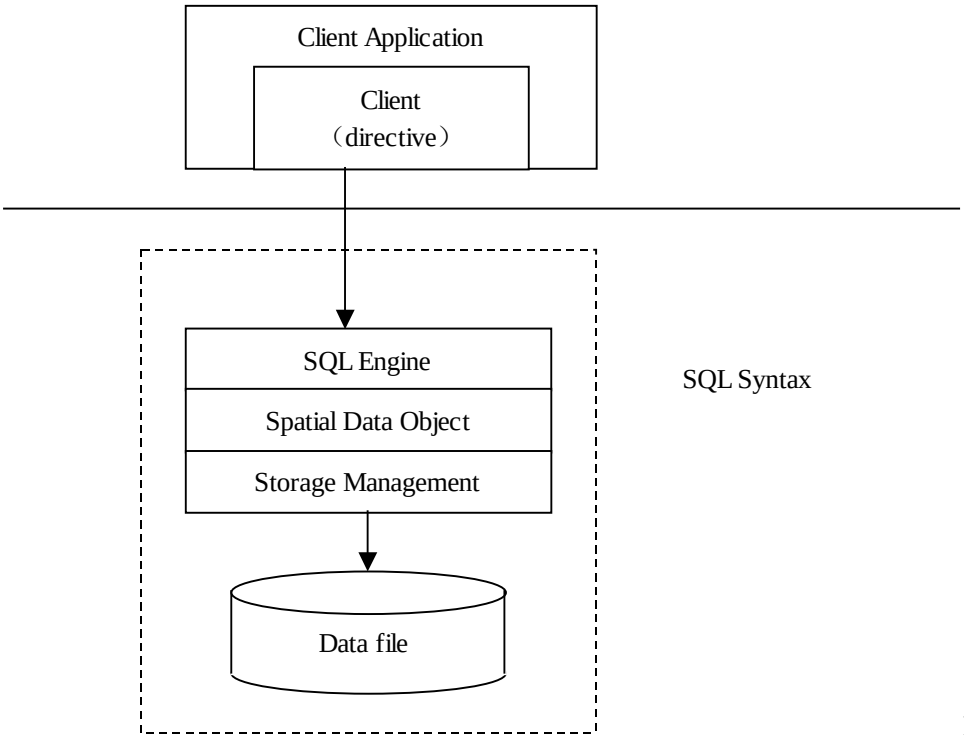


Fig 4. ORACLE’s Software Architecture

In general,SDE and ORACLE spatial integrate spatial and non-spatial data seamlessly.In this way,storage ,management and application on spatial data is realized by DBMS. Then,users can access spatial data safely and efficiently by making use of power of large DBMS. At the same time,the problems of storing spatial and non-spatial data separately are avoided.But,both SDE and ORACLE spatial defines their own special data structure.So,data transformation is needed,which maybe bring about degradition of data precision and data quality.And,data transformation interface must be developed.Users should think over these points and decided carefully whether SDE or ORACLE spatial should be choosed to manage spatial data.

As new technology,both SDE and ORACLE spatial have shortcomings.Although,they support 3D data type,but there are few operations on 3D objects.SDE’s raster index is not effient enough.ORACLE spatial don’t provide application platform and operation interface.And it has no complete spatial data mechanism and data maintance tools,which brings about problems for development and application.Because of these reasons,when choose software,users must plan software structure carefully acoording to system requirement.

4.IMPLEMENTATION

4.1 SATELLITE REMOTE SENSING APPLICATION COMPREHENSIVE DATABASE BASED ON SDE

The task of satellite remote sensing system is to process and interprete images.All kinds of image products are generated,which can be applied in many fields.The main data of the system is images captured by satellite.And other data including documents,digital maps,background images should also be stored for the purpose of supporting image interpretation.ArcSDE is choosed for database server,coupled with ORACLE.Multi-user can access spatial data and non-spatial data.WebGIS server and ArcIMS realize spatial data publishment,ArcView realizes data browsing

and querying.ArcInfo realizes data management and updation.The software architechture See Fig5.

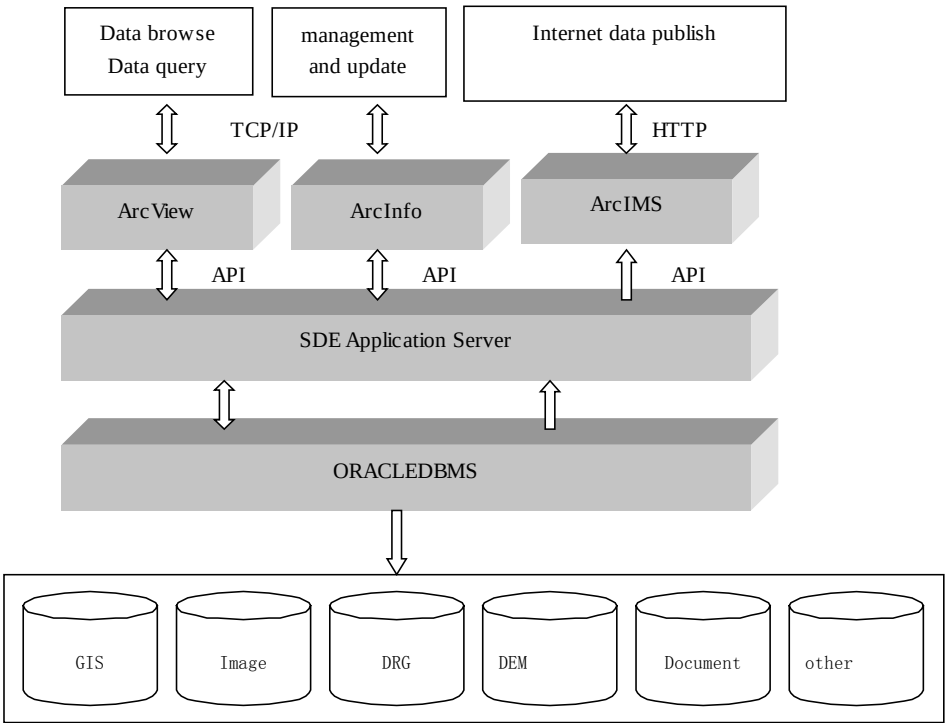


Fig 5. Software Architecture based on SDE

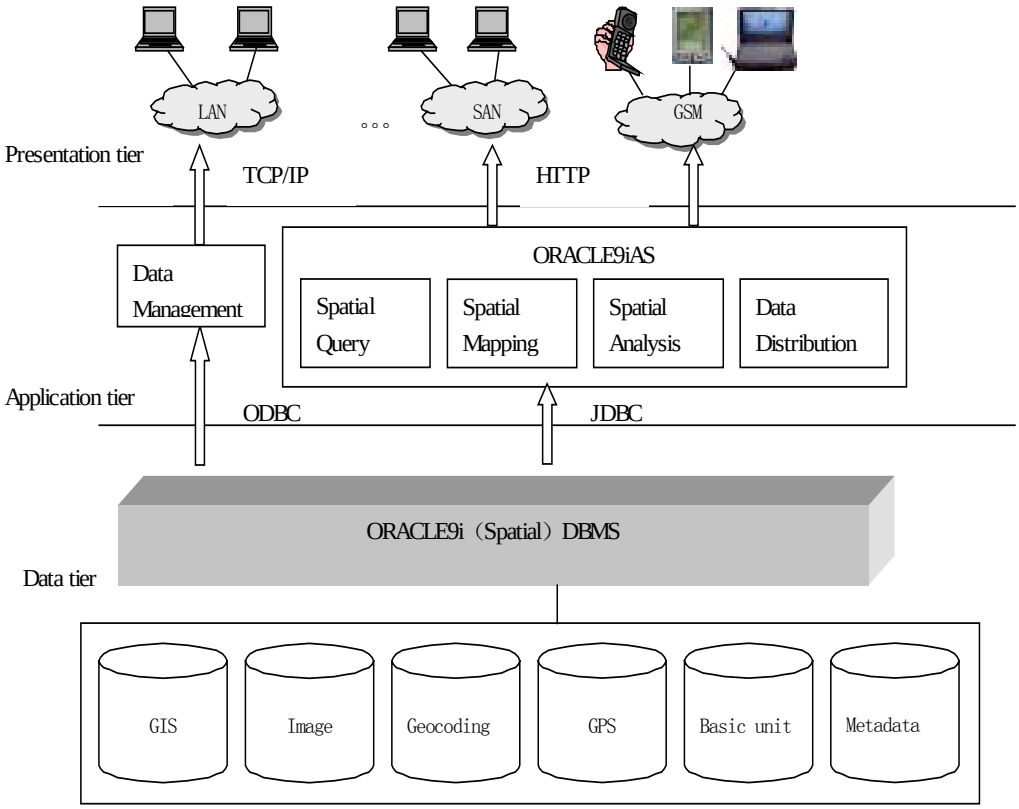
4.2 DIGITAL CITY SPATIAL DATABASE SERVER BASED ON ORACLE SPATIAL

Digital city's spatial data is managed by object-relational database management system,which stores and manages multi-scale,multi-time,multi-sourece spatial data oriented city management and social service.The content of spatial data is just the same as the framework of Urban Spatial Data Infrastructure. The data in spatial database can be classfied into six types: remote sensing images;GIS themes;GPS data;Geoding data;social basic unit data;metadata.**T**he software architechture See Fig 6.

- GIS database
  - 1:500 cadastral map
  - 1:2000,1:5000,1:10000,1:50000,1:250000 topographical map
- Image database
  - 1:10000 DOM(digtial ortho image)
  - 1M,4M,10M,30M high resolution satellite remote sensing image
- Geocoding database
  - Placename
  - Road
  - Building
  - Doorplate
- social and economic basic unit database

- political boundary
- post code boundary
- police boundary (scale is 1:5000,1:2000 is the best)

- GPS database:Store GPS location data.
- Metadata database:Store descriptive information of spatial data



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