OPTIMIZATION OF DATABASE CAPABILITY IN THE E-GOVERNMENTAL SPATIAL AIDED DECISION-MAKING SYSTEM

Bin Li, Jiping Liu, Yi Zhu, Lihong Shi

Chinese Academy of Surveying and Mapping, Beijing ,China -libin@casm.ac.cn

KEY WORDS: Oracle9i database, Optimization, Memory, SQL sentence, Table space

ABSTRACT:

E-governmental Spatial Aided Decision-making System based on GIS and DSS is a representative paradigm in the fields of e-government application.Oracle9i database is adopted is an important aspect of system application. It is a big and complicated run database system whose run efficiency is of great importance to system capability. There are lots of methods of optimization for oracle9i database. This paper proposed some optimizational principles and methods of oracle9i database capability in the aspects of database structure, SQL Sentence and memory assignation, etc. And the system capability has been enhanced to comparatively great extent by using these above-mentioned methods of optimizing database during the course of system application. At last, this paper gave some integrated and further conclusion about optimization of oracle9i database.

1. INTRODUCTION

As a branch of GIS, Government GIS is a universal platform for all levels offices to load diversified data of government affair and specialty. And it is an aided tool to manage government and perform corresponding analysis and decision-making(Qingpu,1999).E-governmrntal spatial aided decision-making system is a representative instance in this field. It is developped mainly by Information Center of State Department and Chinese Academy of Surveying and Mapping and aims to provide a suit of tools to manage government and perform some analysis and decision-making for State Department and local governments.

There are large numbers of basic geographical data and attributed data in e-governmrntal spatial aided decision-making system, such as vector data, grid data, image data, DEM data and statistical data, etc. The large oracle9i database and B/S structure with three layers are adopted during the course of system application. It is very important to optimize the database capability due to using oracle9i database to manage the great capacity of data in the system. In this paper the author represented how to optimize oracle9i database in order to enhance the systemic run efficiency in the fields of database structure, SQL sentence and memory assignation.

2. OPTIMIZATION OF DATABASE STRUCTURE

The optimization of database structure, which includes logical and physical optimization, is the most basic and important method of all optimization methods of database capability because database structure designment can directly affect the capability of application. The logical structure is logically conceptual organic mode, such as table, index, etc. The physical structure denotes actual location of data. Both of them are correlative each other.

2.1 Optimization of Logical Structure

Table space, table and index are three primary parts which constitute the logical structure of oracle9i database. The optimization of logical structure can be done according to the three aspects of designment.

2.1.1 Design of Table Space

Table space is the maximal logical structure used by users in oracle9i database(Oracle University,2002). All the contents constituted by users can be storaged in the table space. The designments of table space are as follows:

a. All the table space should be stored in different disk partitions instead of being in a single disk, which can enhance the capacity of I/O in oracle9i database.

The relation between table space and corresponding files is as follows(see figure 1).

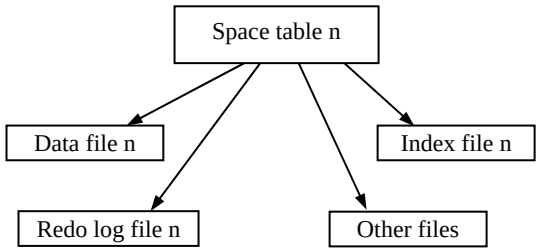

Figure 1. Relation chart of table space and corresponding files

b. The initialization value should be correspondingly bigger according to system requirements and not be extensible automatically in order to enhance the read-write speed of disk I/O in oracle9i database.

c. Different table space should be created according to corresponding logical objects and stored in diverse disks.
d. The table space that is often accessd should stored in individual disk.

2.1.2 Design of Table

Table is the basic logical structure to store data in oracle9i database. The following principles should be adopted in order to enhance the speed of querying when designing the tables.

a. The quantity of table should not be too big and generally not exceed 500000 records.

b. The table can be flatly or vertically divided up several subtables when the different rows or lists are accessed continually during the course of multitransaction processing.

c. The partial rows or lists which can be accessed frequently during the course of primary transaction processing can be detached from those data that can be accessed rarely.

2.1.3 Design of Index

Index is the logical structure to access fleetly the table in oracle9i database (Xianghui,2002).It can enhance the capability of searches greatly in the system. However, using index can not always enhance the speed of searches of all times. The following principles of designing the index should be adopted:

a. The index should be constituted when the selected records don't exceed 20 percent of total records.

b. The index which is often in the condition of searches should be constituted.

c. The sequence of fields in the index should be consistent with the sequence of practical application for the compound indexes.

d. The indes can't be constituted automatically in the field which has foreign key constraint in oracle9i database(Oracle University,2002),which can lead to data lock in the application.

e. The index will be useless under the condition of using functions and logical operators in the index field,such as NOT,IN,OR,NULL and LIKE, etc.

2.2 Optimization of Physical Structure

The data in oracle9i database can be stored ultimaly in the physical disks where the data can be accessed by means of R/W. The important result of optimizing physical structure is to make R/W parallel as far as possible and reduce the competition to disk resource and the unnecessary extend of physical memory structure. Finally, the systemic run efficiency can be enhanced to correspondingly large extent.

The following rules should be adopted during the course of system application:

a. Physical memory address should be distributed reasonablely for logical structure which can be accessed parallelly by oracle9i database and reduce the competition to I/O of disks.
b. Different table space should be established for tables and indexes and distributed in different physical disks.

c. The tables and indexes which are often accessed should be detached in the disks or table space(Huiqin,2003).
d. Data files and redo log files should be stored in different physical disks.

In addition, DBA uses termly EXP/IMP order of DOS to eliminate the fragments produced when system runs. The system efficiency can be enhanced efficiently to some extent by making use of the above-mentioned optimization methods.

3. OPTIMIZATION OF SQL SENTENCE

Optimization of SQL sentence is also an important step to enhance the system capability. The SQL sentences which have been compiled should be classified according to operating type and find out corresponding coding rules on the basis of the configuration of oracle9i database during the course of system exploitation.

The most predigestion and efficiency of searching data are the key to optimize SQL sentence. However, the factors affecting the speed of executing SQL sentence mainly include the following aspects: writing rule of SQL sentences, application of index, sequence of executing sentences, etc. During the system application the following methods should be adopted.

a. The uniform coding rules and writing criterion of SQL should be adopted to reduce the degrees of parsing.

b. To the best of its ability to avoid scaning the whole table, which occupies too much system resource.

c. The single or compound index should be constituted in a field or several fields. The sequence of index fields in compound index must be consistent with the fields in the table.

d. The logical operators, such as NOT,IN,OR,NULL and LIKE, should avoid to be used. The system can make use of other operators to substitute and ensure the efficiency of index.

e. If selectivity conditions are involved in the clause of WHERE, the parts being upmost should be placed the aftermost of expression (Rongbing, 2002) and enhance the efficiency of parsing.

f. The SQL sentences should be arranged executing as a group and commit concentratively (Xuezhong, 2003) instead of the mode of commiting automatically.

4. OPTIMIZATION OF MEMORY ASSIGNATION

Memory can affect remarkably the capability of system based on oracle9i database. To distribute and optimize memory is the most important step to optimize database and enhance the system capability. The optimization of system global area(SGA) is primary component part in optimization of memoey assignation during the course of system application. SGA is the important area in memory to store common information accessed by all user courses in oracle9i database. When the instance of oracle9i database starts, SGA and its memory structure of accessorial parts will be established in the system. It can affect all the process and capability of all sessions. The optimization of memory mainly includes the optimization of composing the structure of SGA.SGA mainly includes three parts:database buffer cache,shared pool and redo log buffer.

4.1 Database buffer cache

Database buffer cache is used to store data blocks accessed from the disk recently and modification which has not be saved in the disk(Jianxin,2003).Generally speaking, the system capability will be more well if the value of database buffer cache is more big. However,the system capability can not be always well with the increase of the value if considering the holistic capability of system. The system will be busy relatively and occupy too resource to debase the system capability if database buffer cache occupys too space.

The efficiency of database buffer cache can be incarnated by hit ratio(Oracle University,2002) whose value can be educed from corresponding parameter in the dynamic view V$syssta. The formula is as follows:

Hit ratio =1-(physical reads-physical reads direct-physical reads direct(lob)/ session logcial reads.
Thereinto: physical reads denotes the amount of blocks accessed from the disks,
physical reads direct denotes the amount directly accessed,
physical reads direct(lob) denotes the amount of large binary objects directly accessed,
session logcial reads denotes the amount of logcial reads.

The system capability is well if hit ratio exceeds 85 percent.
For example, hit ratio can be educed according to the following SQL sentence in e-governmental spatial aided decision-making system.The result has exceeded 85 percent.

```
SQL>  Select name,value
2   from   V$sysstat
3   where name in('Session logcial reads', 'physical reads',
4   'physical reads direct', 'physical reads direct(lob) )';
```

The hit ratio can be adjusted according to corresponding parameter db_block_size in initialization files namely init. ora if it descends owing to the resource competition and occupying when the system runs.

4.2 Shared pool

Shared pool is used to store SQL,PL/SQL package,lock and data dictionart.It includes three parts:library cache,data dictionary cache and user global area.Its value can be educed according to the parameter Shared_pool_size in initialization files namely init.ora.

4.2.1 Library cache

Library cache,which includes shared and private areas where the system can analyse and execute the SQL sentences,is used to store SQL and PL/SQL sentences which are recently used.Shared SQL area is used to store analytical tree and process of executing.The system can use identical shared SQL area for the same multi SQL sentences.Private SQL area is used to save the corresponding information when SQL sentences run, converting information of data type and cursor information.Its value can rise with the amount of data fileds in SQL sentences.In the system of distributed database,Oracle9i database can apply for some space for private SQL sentences according to needs from every undependent server.Whereas,the space can be given from SGA in a multithreading server(Ningjun,2003).

The efficiency of library cache can be incarnated by hit ratio whose value can be educed from corresponding parameter in the dynamic view V$LibraryCache. The formula is as follows:

Hit ratio=1-sum(pins)/(sum(pins)+sum(reloads))
Thereinto: pins denotes the value accessed from the memory,
sum(pins) denotes corresponding sum,
reloads denotes the numerical value accessed from the disks,
sum(reloads) denotes corresponding sum.

The system capability is well if hit ratio exceeds 90 percent.
For example, hit ratio can be educed according to the following SQL sentence in e-governmental spatial aided decision-making system.The result has exceeded 90 percent.

```
SQL>  Select sum(pins)    "Executions",
2  sum(reloads) "Cache Misses",
3  from  V$LibraryCache;
```

4.2.2 Data dictionary cache

Data dictionary cache is used to store structural information of database, userinfo and other information, such as table and index, etc. It can affect the system capability to large extent. The efficiency of measuring data dictionary cache can be incarnated by hit ratio which can be educed according to corresponding parameter in dynamic view V$RowCache.The formula is as follows:
Hit ratio =1-sum(getmisses)/(sum(getmisses)+sum(gets))
Thereinto: getmisses denotes the numerical value accessed from the disks,
sum(getmisses) denotes corresponding sum,
gets denotes the value accessed from the memory,
sum(gets) denotes corresponding sum.

The system capability is well if hit ratio exceeds 90 percent.
For example,hit ratio can be educed according to the following SQL sentence in e-governmental spatial aided decision-making system.The result has exceeded 90 percent.

```
SQL>  Select sum(gets), sum(getmisses)
      2   from  V$RowCache;
```

4.2.3 User global area

The status messages of cursor and user session information can be stored in user global area(UGA) in shared server mode(Oracle University,2002).The latter also includes sort and private SQL.Comparing with SGA,the value of UGA is comparatively little and can be educed according to corresponding parameter in dynamic view V$Sesstat.

4.3 Redo log buffer

Storing all redo log information before writing redo log files is the main function of redo log buffer.when users modify the database The system will write modified records to redo log buffer firstly and write to redo log files(Huiqin,2003).The optimization aim in these areas is to ensure having sufficient memory space.The efficiency can be adjusted according to the attributed value 'Redo buffer allocation retries' of dynamic view V$sysstat.The value can be close to 0 and less than 1% of whole area(Oracle University,2002).The idiographic SQL sentencesare as follows:

```
SQL> Select name, value

      2   from  V$sysstat
      3   where name='Redo buffer allocation retries';
```

5.APPLICATION EXAMPLES

During the system construction and application,as the DBA,the author made a series of experiments and adopted some optimization methods to enhance the run efficiency of e-governmental system according to above-mentioned optimization principles under the following condition of software,hardware and data.The consequential contrast between optimization and unoptimization is as follows(see figure 2).

Optimization type	Examples	Consumed time before optimization(s)	Consumed time after optimization(s)
Table space	Initialization operation	About 7s	About 3s
Index	Initialization operation	About 9s	About 3-4s
SQL sentence	Placename index	About 20s	About 9s
Database buffer	Dispatchment and show of vectorgraph of 1:250000	About 6s	About 2-3s
Shared pool	Buffer analysis of single factor	About 7s	About 3s

Figure 2. Consequential contrast between optimization and unoptimization

5.1 Hardware condition

a.Server:DELL2.0 server,memory-1024M, hard disk-80G;
b.Client: memory-128M, CPU-upwards of P586.

5.2 Soft condition

a.Server:OS-Windows 2000 sever,database-oracle9i,.NET run condition;
b.Client:OS-Windows 2000/XP,browser-upwards of IE5.0,Java virtual machine-1.2x/1.3x,TCP/IP.

5.3 Data quantity

About 19G.

According to figure 2,the run speed after optimization has almost doubled comparing to unoptimization by adopting corresponding methods.Taking one with another,it is a relatively high elevated speed.The run efficiency and speed of the system have been enhanced and optimized to great extent.

6. CONCLUSION

It is a complicated and enormous run system for the e-governmental spatial aided decision-making. The optimization of oracle9i database is a long and continually variational process with the development of time due to great capacity of different data.It involves a lot of work and need often track diversified statistical targets and analyse the cause of capability changement.At last,different aspects of factors must be synthetically considered in order to enhance the run efficiency of the system.During the course of system construction,DBA must analyse carefully different requirements and configure rationally diversified parameters about database structure,SQL sentence and memory assignation so that the run sysrem based on oracle9i database can be at its best and improve the decision-making efficiency of e-government.

REFERENCES

Huiqin Zhao.(2003).Optimization Tactic of Application System of Oracle Database,2003(27).

Jianxin Gou.(2003).Capability Optimization Skills of Oracle9i Database. Transaction of Hubei Automobile Industry Institute,2003,17(3).

Ningjun Shao.(2003).Optimization Tactic of Oracle Database Capability.Computer and modernization,2003(8).

Oracle9i Database Performance Tuning.Oracle University,CA,USA,Volume One,2002.

Qingpu Zhang,Foxiao Chen.(1999).Basic Conception and Construction Mode of Governmental Geographic Information System. Remote Sensing Information,1999 supplement.

Rongbing Bian.(2002).Research of Capability Optimization Based on Oracle Database.Application Technique,2002(9).

Xuezhong Li.(2003).Optimization Use of Oracle Database.Technic of Electronic Technology,2003(9).

Xianghui Chen.(2002).Optimization of Search Capability of Internet Applications System Based on Oracle.Transaction of Hebei Technology University,2002,23(1).

Yonghua Hu.(2003).Capability Optimization of Oracle Database.Technique of Yunnan Electric Power,2003,31(2).