

# Xtreme SQL Tuning: The Tuning Limbo

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#### **NoCOUG Fall Meeting 2008**



## **Speaker Qualifications**

- Oracle DBA at Database Specialists
- Editor of the Journal of the Northern California Oracle Users Group
- Author of Beginning Oracle Database 11g Administration



# **Definition of SQL Efficiency**

- Amount of computing resources used in producing the output
- Elapsed time is not a good proxy
- Logical reads is a good proxy



# **Identifying Inefficient SQL Statements**

- Enterprise Manager, SQL Developer, Toad
- Tracing sessions
  - dbms\_monitor.session\_trace\_enable
  - dbms\_monitor.session\_trace\_disable
- Statspack reports
- Diagnostic Pack
  - AWR
  - ADDM



## **Causes of Inefficient SQL**

- Optimizer limitations
- Many ways to write a query
- Failure to use advanced features
  - Analytic Functions
- Ad-hoc queries
- Poor logical and physical database design
- Inadequate database maintenance



## **Other Performance Inhibitors**

- Hardware limitations
- Mixed workloads
- Contention



## Ways to Improve SQL— Physical Database Design

#### Indexes

- B-tree indexes
- Reverse key indexes
- Function-based indexes
- Indexes on virtual columns
- Bitmap indexes
- Clusters
- IOTs
- Partitioning



## Ways To Improve SQL— Hints

- LEADING
- ORDERED
- INDEX
- FULL
- NO\_MERGE
- USE\_NL, USE\_HASH, USE\_MERGE



## Ways To Improve SQL— Statistics

- ENABLE\_JOB, DISABLE\_JOB, START\_JOB
- GATHER\_\*\_STATS
- DELETE\_\*\_STATS
- EXPORT\_\*\_STATS
- IMPORT\_\*\_STATS
- RESTORE\_\*\_STATS
- LOCK\_\*\_STATS
- SET\_\*\_PREFS



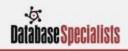
"It astonishes me how many shops prohibit any unapproved production changes and yet reanalyze schema stats weekly. Evidently, they do not understand that the purpose of schema reanalysis is to change their production SQL execution plans, and they act surprised when performance changes!"

—Don Burleson



*"I have advised many customers to stop analyzing, thereby creating a more stable environment overnight."* 

-Mogens Norgaard in the NoCOUG Journal



"Oh, and by the way, could you please stop gathering statistics constantly? I don't know much about databases, but I do think I know the following: small tables tend to stay small, large tables tend to stay large, unique indexes have a tendency to stay unique, and non-unique indexes often stay non-unique."

—Dave Ensor as remembered by Mogens Norgaard and quoted in the NoCOUG Journal



"Monitor the changes in execution plans and/or performance for the individual SQL statements ... and perhaps as a consequence re-gather stats. That way, you'd leave stuff alone that works very well, thank you, and you'd put your efforts into exactly the things that have become worse." —Mogens Norgaard, in the NoCOUG Journal



"It is my firm belief that most scheduled statisticsgathering jobs do not cause much harm only because (most) changes in the statistics were insignificant as far as the optimizer is concerned—meaning that it was an exercise in futility."

—Wolfgang Breitling in the NoCOUG Journal



"There are some statistics about your data that can be left unchanged for a long time, possibly forever; there are some statistics that need to be changed periodically; and there are some statistics that need to be changed constantly. ... The biggest problem is that you need to understand the data."

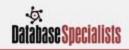
—Jonathan Lewis in the NoCOUG Journal



## **Tuning By Example**

```
CREATE TABLE my_tables AS
SELECT dba_tables.*
FROM dba_tables;
```

CREATE TABLE my\_indexes AS
SELECT dba\_indexes.\*
FROM dba\_tables, dba\_indexes
WHERE dba\_tables.owner = dba\_indexes.table\_owner
AND dba tables.table name = dba indexes.table name;



## **Tables Which Have a Bitmap Index**

EXEC :index\_type := 'BITMAP';

```
SELECT DISTINCT my_tables.owner,
    my_tables.table_name,
    my_tables.tablespace_name
    FROM my_tables, my_indexes
    WHERE my_tables.owner = my_indexes.table_owner
    AND my_tables.table_name = my_indexes.table_name
    AND my_indexes.index_type = :index_type;
```



#### Autotrace

ALTER SYSTEM FLUSH SHARED\_POOL; ALTER SYSTEM FLUSH BUFFER\_CACHE;

- 1653 recursive calls
  - 0 db block gets
  - 498 consistent gets
  - 137 physical reads
    - 0 redo size
  - 645 bytes sent via SQL\*Net to client
  - 381 bytes received via SQL\*Net from client
    - 2 SQL\*Net roundtrips to/from client
    - 37 sorts (memory)
      - 0 sorts (disk)
    - 5 rows processed



#### Autotrace

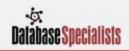
#### ALTER SYSTEM FLUSH BUFFER\_CACHE;

- 0 recursive calls
- 0 db block gets
- 108 consistent gets
- 104 physical reads
  - 0 redo size
- 645 bytes sent via SQL\*Net to client
- 381 bytes received via SQL\*Net from client
  - 2 SQL\*Net roundtrips to/from client
  - 0 sorts (memory)
  - 0 sorts (disk)
  - 5 rows processed



## **Baseline**

- 0 recursive calls
- 0 db block gets
- 108 consistent gets
  - 0 physical reads
  - 0 redo size
- 645 bytes sent via SQL\*Net to client
- 381 bytes received via SQL\*Net from client
  - 2 SQL\*Net roundtrips to/from client
  - 0 sorts (memory)
  - 0 sorts (disk)
  - 5 rows processed



## **Execution Plan I**

Operation		Name	Buffers
	 	MY_INDEXES MY_TABLES	<b>108</b> 108 58 50

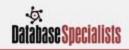


#### Constraints

ALTER TABLE my\_tables ADD (CONSTRAINT my\_tables\_pk PRIMARY KEY (owner, table\_name));

ALTER TABLE my\_indexes ADD (CONSTRAINT my\_indexes\_pk PRIMARY KEY (owner, index\_name));

ALTER TABLE my\_indexes ADD (CONSTRAINT my\_indexes\_fk1 FOREIGN KEY (table\_owner, table\_name) REFERENCES my\_tables);



#### Indexes

CREATE INDEX my\_indexes\_i1 ON my\_indexes
(index\_type);

CREATE INDEX my\_indexes\_fk1 ON my\_indexes
(table\_owner, table\_name);



```
EXEC
DBMS STATS.gather table stats(ownname=>'IFERNANDEZ'
,tabname=>'MY TABLES');
EXEC
DBMS_STATS.gather_table_stats(ownname=>'IFERNANDEZ'
,tabname=>'MY INDEXES');
EXEC
DBMS STATS.gather index stats(ownname=>'IFERNANDEZ'
, indname => 'MY TABLES PK');
EXEC
DBMS STATS.gather index stats(ownname=>'IFERNANDEZ'
, indname => 'MY INDEXES I1');
EXEC
DBMS STATS.gather index stats(ownname=>'IFERNANDEZ'
, indname => 'MY INDEXES FK1');
```



### **Execution Plan II**

Operation	Name	Buffers
HASH UNIQUE HASH JOIN TABLE ACCESS BY INDEX ROWID INDEX RANGE SCAN TABLE ACCESS FULL	MY_INDEXES MY_INDEXES_I1 MY_TABLES	55 55 5 2 50



## **SQL Access Advisor**

```
VARIABLE tuning_task VARCHAR2(32);
EXEC :tuning_task :=
dbms_sqltune.create_tuning_task (sql_id =>
'&sqlID');
```

EXEC dbms\_sqltune.execute\_tuning\_task(task\_name =>
:tuning\_task);

SELECT DBMS\_SQLTUNE.report\_tuning\_task
(:tuning\_task) AS recommendations
FROM DUAL;



#### Recommendations

The execution plan of this statement can be improved by creating one or more indices.

Recommendation (estimated benefit: 100%)

- Consider running the Access Advisor to improve the physical schema design or creating the recommended index. create index IFERNANDEZ.IDX\$\$\_00470001 on IFERNANDEZ.MY\_TABLES('OWNER', 'TABLE\_NAME','TABLESPACE\_NAME');



#### Hints

#### EXEC :index\_type := 'BITMAP';

\* /

#### SELECT

- /\*+ INDEX(MY\_INDEXES (INDEX\_TYPE))
   INDEX(MY\_TABLES (OWNER TABLE\_NAME))
   LEADING(MY\_INDEXES MY\_TABLES)
   USE\_NL(MY\_TABLES)
- DISTINCT my\_tables.owner, my\_tables.table\_name, my\_tables.tablespace\_name FROM my\_tables, my\_indexes WHERE my\_tables.owner = my\_indexes.table\_owner AND my\_tables.table\_name = my\_indexes.table\_name AND my\_indexes.index\_type = :index\_type;



## **Execution Plan III**

Ī	Operation	Name	Buffers
Ī	HASH UNIQUE NESTED LOOPS		37 37
1	TABLE ACCESS BY INDEX ROWID	MY_INDEXES	5
	INDEX RANGE SCAN	MY INDEXES I1	2
	TABLE ACCESS BY INDEX ROWID	MY_TABLES	32
	INDEX UNIQUE SCAN	MY_TABLES_PK	17





#### CREATE CLUSTER my\_cluster (index\_type VARCHAR2(27)) SIZE 8192 HASHKEYS 5;



#### **Materialized View**

CREATE MATERIALIZED VIEW LOG ON my tables WITH ROWID; CREATE MATERIALIZED VIEW LOG ON my indexes WITH ROWID; CREATE MATERIALIZED VIEW my mv CLUSTER my cluster (index type) REFRESH FAST ON COMMIT ENABLE QUERY REWRITE AS SELECT t.ROWID AS table rowid, t.owner AS table owner, t.table\_name, t.tablespace name, i.ROWID AS index rowid, i.index type FROM my tables t, my\_indexes i WHERE t.owner = i.table owner

AND t.table\_name = i.table\_name; 31



## **Execution Plan IV**

Operation	Name	Buffers
HASH UNIQUE TABLE ACCESS	HASH MY_MV	1   1



#### **Result Cache**

#### SELECT

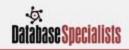
#### /\*+ RESULT\_CACHE \*/

- DISTINCT my\_tables.owner,
  - my\_tables.table\_name,
    - my\_tables.tablespace\_name
  - FROM my\_tables, my\_indexes
  - WHERE my\_tables.owner = my\_indexes.table\_owner
    - AND my\_tables.table\_name = my\_indexes.table\_name
    - AND my\_indexes.index\_type = :index\_type;



## **Execution Plan V**

I	Operation	Name
	SELECT STATEMENT RESULT CACHE HASH UNIQUE TABLE ACCESS HASH	afscr8p240b168b5az0dkd4k65 MY MV



## White Paper

- Contains all of the material we discussed today and more
- Code samples are easier to read
- Easier to cut and paste the code for testing on your system
- Download:

www.dbspecialists.com/presentations



## **Contact Information**

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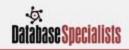
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- We specialize in short term projects including upgrades, performance tuning and health checks.
- Our Oracle DBAs each have a minimum of 10 years of Oracle experience with a focus on Oracle technology, mission-critical production support and RAC environments.
- Database Specialists is US-based.

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