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锻造凝练IT服务 助推用户事业发展

Oracle根因分析案例分享

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关于小y-技术即人生

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黄远邦

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简称：中亦科技、中亦安图

十年以上Oracle数据库维护经验，擅长数据库架构设计、复杂故障、复杂性能问题定位和解决。
带领数十人的服务团队为客户提供数据库运维专家服务

数年来为数十家银行总行客户提供数据库专家服务
此外为航空、证券、基金、保险、运营商、政府、制造业等众多客户提供数据库维护服务

关于根因分析

- 什么是根因分析
- 根因分析的好处
- 怎么做根因分析

为什么做DBA/开发这么累（kaixin）

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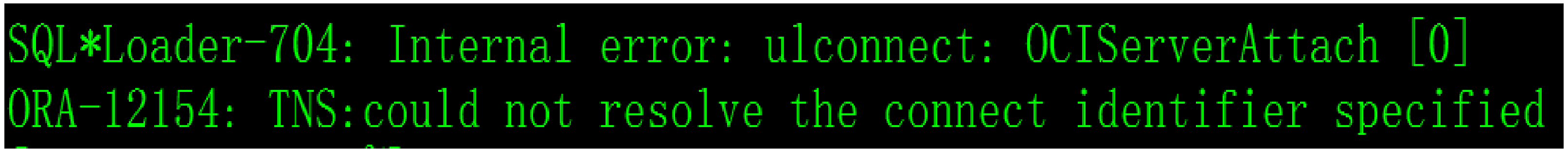
- 出现问题后，没有查明根本原因，反复加班
- 没有由点带面的意识，其他系统也反复出现
- 流程上没有把控制环节往前移到开发、上线前的环节

小y的感受是：
做DBA(技术) 其实是一件非常有意思的事情
只要**基础**扎实，掌握**方法**，再结合一些丰富的**想象力**，就如何侦探破案般有意思！
让我们来经历一次**破案**之旅吧！

故障现象-夜间批量不时报ORA-12154错误

- 夜间批量,sqlldr入库不时报ORA-12154错误

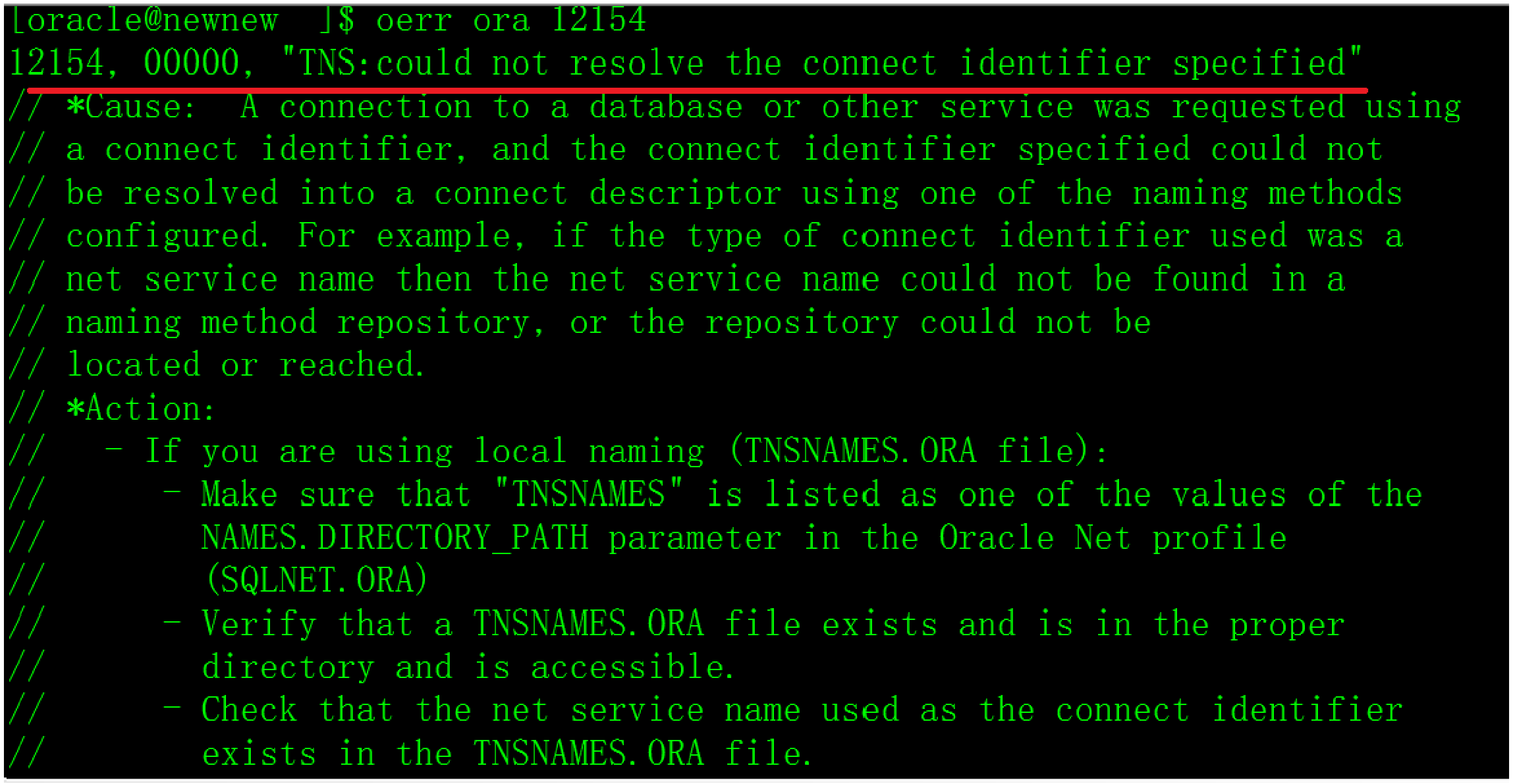


```
SQL*Loader-704: Internal error: ulconnect: OCIServerAttach [0]
ORA-12154: TNS:could not resolve the connect identifier specified
```

- 错误发生后，重提运行成功，原因未明
- 出现问题不立刻处理会影响到第二天白天的业务，处理又老要夜间加班，客户难免感觉到累

客户的疑惑：
跑了几年了，好好的，最近开始出现，而且越来来频繁，到底怎么了？！

什么是ORA-12154错误



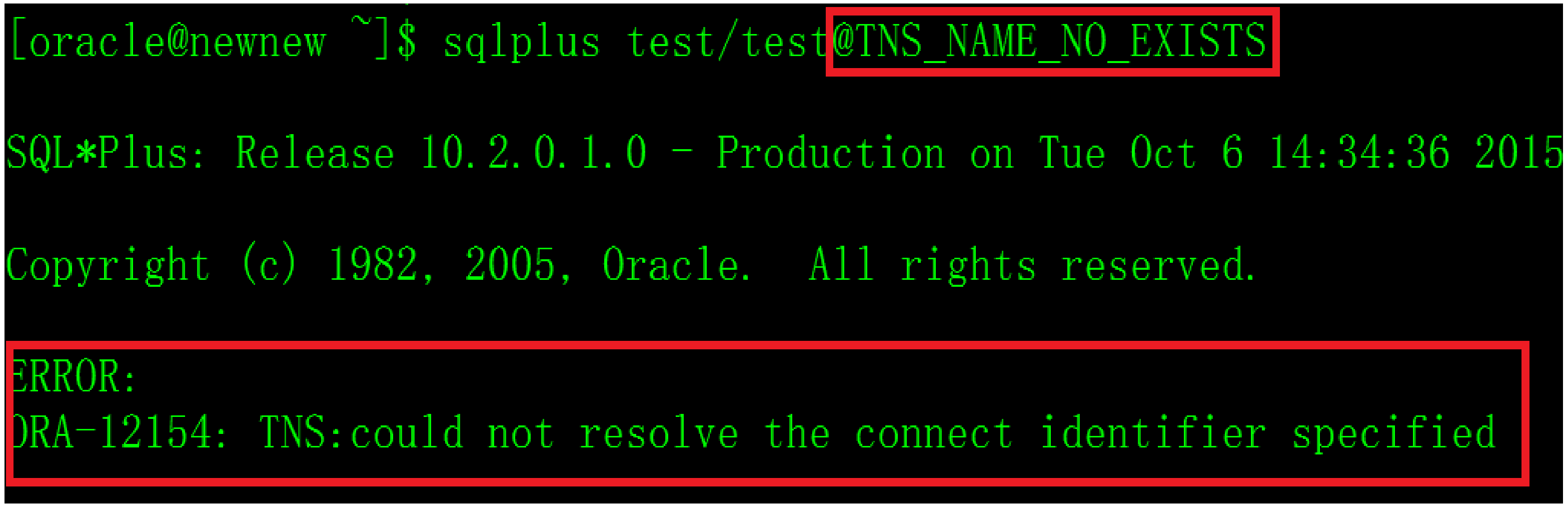
```
[oracle@newnew  ]$ oerr ora 12154
12154, 00000, "TNS:could not resolve the connect identifier specified"
// *Cause:  A connection to a database or other service was requested using
// a connect identifier, and the connect identifier specified could not
// be resolved into a connect descriptor using one of the naming methods
// configured. For example, if the type of connect identifier used was a
// net service name then the net service name could not be found in a
// naming method repository, or the repository could not be
// located or reached.
// *Action:
//   - If you are using local naming (TNSNAMES.ORA file):
//      - Make sure that "TNSNAMES" is listed as one of the values of the
//        NAMES.DIRECTORY_PATH parameter in the Oracle Net profile
//        (SQLNET.ORA)
//      - Verify that a TNSNAMES.ORA file exists and is in the proper
//        directory and is accessible.
//      - Check that the net service name used as the connect identifier
//        exists in the TNSNAMES.ORA file.
```

错误的本质

➢ 该错误的本质是

- TNS别名在tnsnames.ora中找不到定义
- 无法解析

➢ 测试



```
[oracle@newnew ~]$ sqlplus test/test@TNS_NAME_NO_EXISTS

SQL*Plus: Release 10.2.0.1.0 - Production on Tue Oct 6 14:34:36 2015

Copyright (c) 1982, 2005, Oracle.  All rights reserved.

ERROR:
ORA-12154: TNS:could not resolve the connect identifier specified
```

头脑风暴

- ➢ $ORACLE_HOME/network/adminTnsnames.ora里找不到别名定义？或者没有读权限？
- 测试OK，文件的创建和修改时间没有变化。
- 那为什么失败重提以后又不报错了呢？排除！
- ➢ 设置了TNS_ADMIN环境变量，找不到tnsnames.ora文件
- 那为什么失败重提以后又不报错了呢？排除！
- ➢ 为什么跑了好几年，最近才开始出现呢？
- 经了解，做过一个存储磁盘的变更。跟这没关系啊
- ➢ 为什么不是总出现呢？

到底还有什么可能的原因呢？ 抓狂…
是不是漏掉了什么线索？ 需要回到原点

回到原点重新梳理流程

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1、主脚本根据配置文件/home/apuser/db.cfg
配置文件中定义了username=xx,tnsnames=xx
2、动态生成sqlloader的脚本/home/work/sqlldr.sh
脚本内容类似 sqlldr xx/xx@TNS_NAME ……

↓

3、执行sqlloader /home/work/sqlldr.sh

↓

4、不时报ORA-12154错误，即oracle客户端无法解析TNS别名，但重提后问题解决

要像侦探一样仔细！

哪个环节可能有问题呢

侦破线索

1. 重点在于　sqlldr xx/xx@TNS_NAME

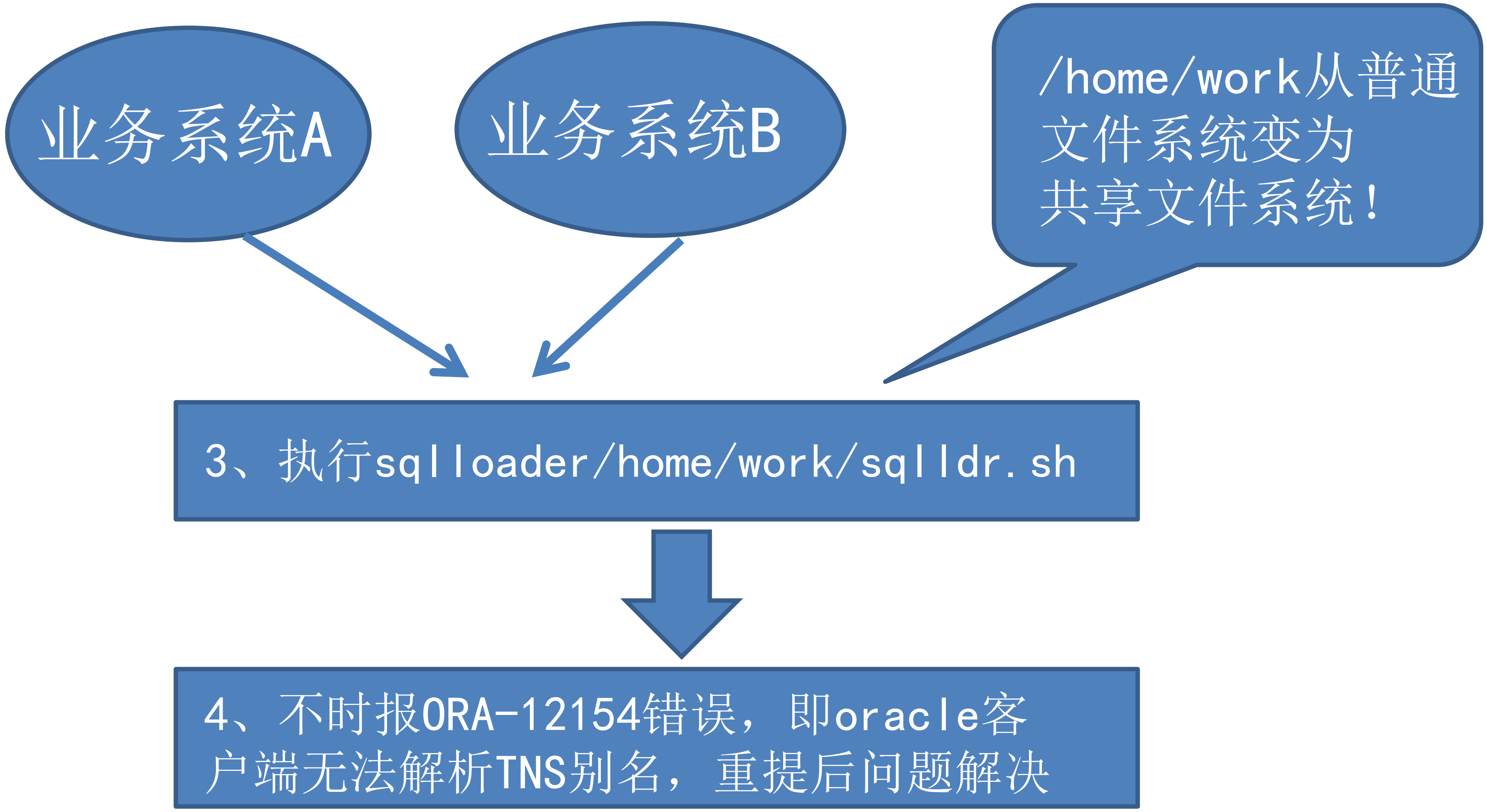
这里的TNS_NAME，有时在tnsnames.ora中找不到定义！

2. 围绕这个线索，请大家思考可能哪个环节出了问题！

有没有不起眼，被忽略和遗漏的线索呢？

做过一个存储磁盘的变更?

真相大白


业务系统A

业务系统B

/home/work从普通文件系统变为共享文件系统！

3、执行sqlloader/home/work/sqlldr.sh

4、不时报ORA-12154错误，即oracle客户端无法解析TNS别名，重提后问题解决

可以回答所有问题了！

1、为什么偶尔出？

当业务系统B覆盖掉sqlldr.sh的时候，里面带的TNS_NAME指向的是业务系统B的数据库别名，自然在业务系统A的TNSNAMES.ORA中无法找到

2、为什么以前不出？后来才出？

文件系统最近被改造为共享文件系统！

看上去一开始被忽略的线索，需要深究！

做DBA也可以像做侦探一样有意思！

下一个案例

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最近刚刚发出的故障（数据文件头损坏）

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问题-操作系统异常掉电后数据库无法启动

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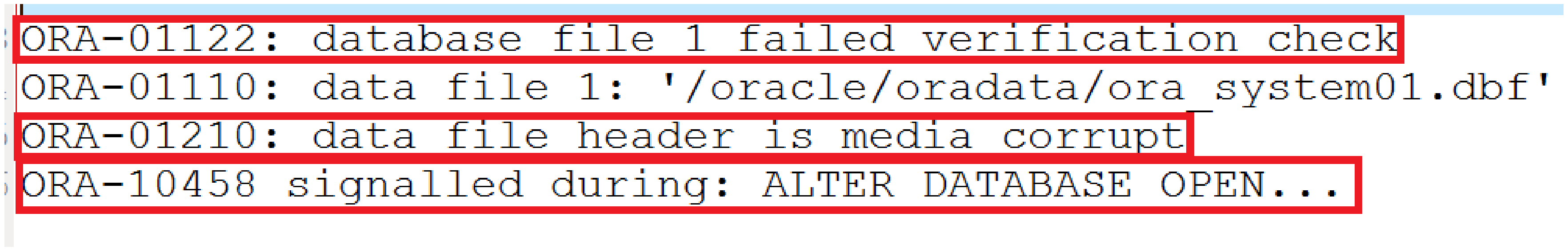
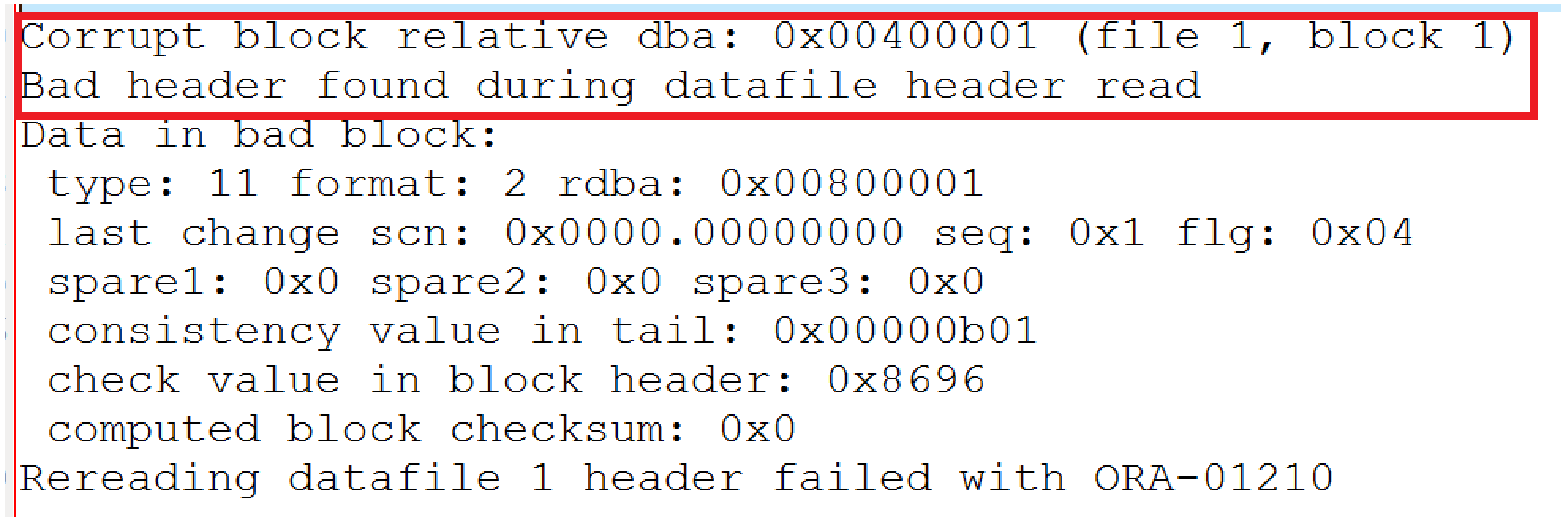


```
ORA-01122: database file 1 failed verification check
ORA-01110: data file 1: '/oracle/oradata/ora_system01.dbf'
ORA-01210: data file header is media corrupt
ORA-10458 signalled during: ALTER DATABASE OPEN...
```



```
Corrupt block relative dba: 0x00400001 (file 1, block 1)
Bad header found during datafile header read
Data in bad block:
 type: 11 format: 2 rdba: 0x00800001
 last change scn: 0x0000.00000000 seq: 0x1 flg: 0x04
 spare1: 0x0 spare2: 0x0 spare3: 0x0
 consistency value in tail: 0x00000b01
 check value in block header: 0x8696
 computed block checksum: 0x0
Rereading datafile 1 header failed with ORA-01210
```

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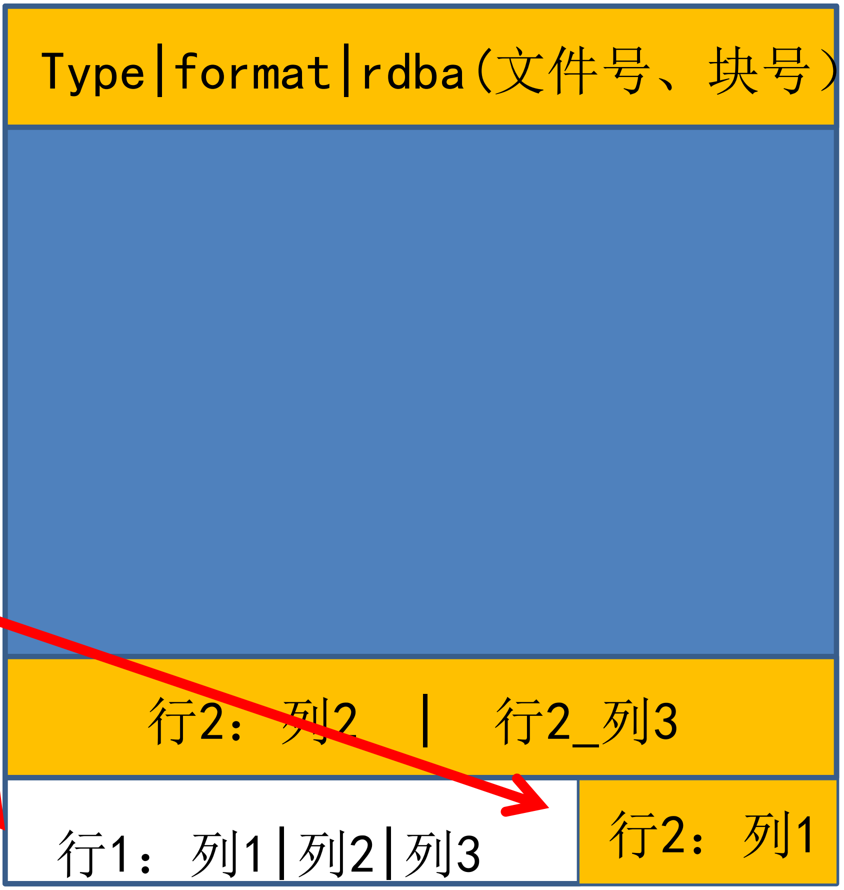
如果是你遇到这样的错误怎么办？

```
#########RDBA即数据块地址

十六进制                十进制
--------------------    --------------
0X00800001              8388609

#########RDBA转变成文件号、块号
select
dbms_utility.DATA_BLOCK_ADDRESS_FILE(8388609)  file_no,
dbms_utility.DATA_BLOCK_ADDRESS_BLOCK(8388609) block_no
from dual;

file_no    block_no
---------  ----------
   2          1
```

这个错误到底表示什么意思-数据块格式存储

Row directory
第1行的offset 0到20
第2行的offset 20到50
…
第n行的offset xx到yy

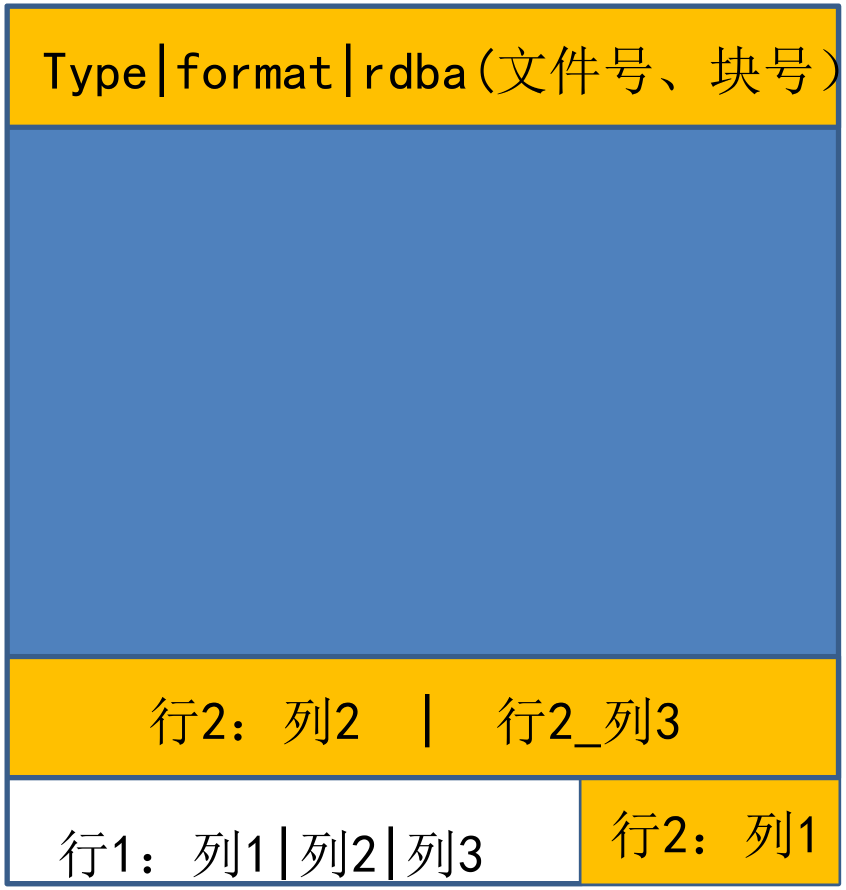


数据块格式存储

Oracle开始读取1号文件1号块，1号文件2号块

…

但是当读到1号文件1号块后，校验块的格式，发现第4到第7个字节的RDBA其实是2号文件1号块



遇到这样的问题要冷静！

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1、无法找到问题原因，则问题反复发生

2、无法找到问题原因，盲目进行处理，使得问题变得更糟糕

3、无法找到问题原因，使得问题处理更发杂，业务受影响的时间更长

环境介绍和客户反馈的信息

1、基础环境：

rhel x86_64bit

oracle 11.2.0.4.6

数据文件存放在裸设备上

2、备份情况：

无备份！

3、客户初步判断：

主机重启后，操作系统把数据文件的头给重写了！！

导致1号文件文件头损坏，继而数据库无法启动！

接下来如果是你，怎么处理？

客户的选择

由于无法查到原因

数据库又无法打开

所以客户开始准备使用DUL软件对数据文件进行抽取

（也有些客户选择设置隐含参数，强行拉库，后面你会发现完全不可行！）

DUL bootstrap直接抽数报错，求助我们

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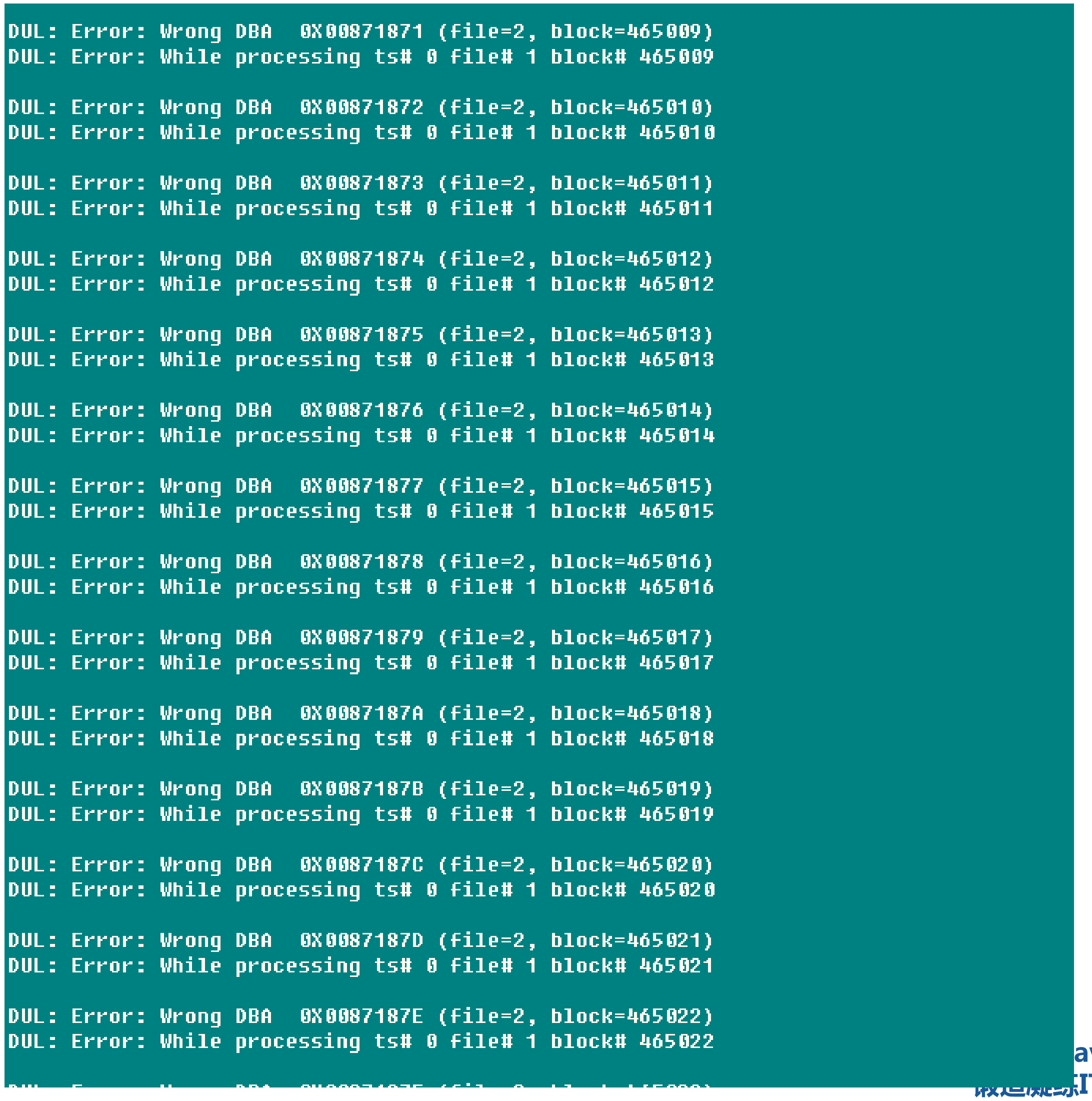

```
DUL: Error: Wrong DBA  0X00871871 (file=2, block=465009)
DUL: Error: While processing ts# 0 file# 1 block# 465009

DUL: Error: Wrong DBA  0X00871872 (file=2, block=465010)
DUL: Error: While processing ts# 0 file# 1 block# 465010

DUL: Error: Wrong DBA  0X00871873 (file=2, block=465011)
DUL: Error: While processing ts# 0 file# 1 block# 465011

DUL: Error: Wrong DBA  0X00871874 (file=2, block=465012)
DUL: Error: While processing ts# 0 file# 1 block# 465012

DUL: Error: Wrong DBA  0X00871875 (file=2, block=465013)
DUL: Error: While processing ts# 0 file# 1 block# 465013

DUL: Error: Wrong DBA  0X00871876 (file=2, block=465014)
DUL: Error: While processing ts# 0 file# 1 block# 465014

DUL: Error: Wrong DBA  0X00871877 (file=2, block=465015)
DUL: Error: While processing ts# 0 file# 1 block# 465015

DUL: Error: Wrong DBA  0X00871878 (file=2, block=465016)
DUL: Error: While processing ts# 0 file# 1 block# 465016

DUL: Error: Wrong DBA  0X00871879 (file=2, block=465017)
DUL: Error: While processing ts# 0 file# 1 block# 465017

DUL: Error: Wrong DBA  0X0087187A (file=2, block=465018)
DUL: Error: While processing ts# 0 file# 1 block# 465018

DUL: Error: Wrong DBA  0X0087187B (file=2, block=465019)
DUL: Error: While processing ts# 0 file# 1 block# 465019

DUL: Error: Wrong DBA  0X0087187C (file=2, block=465020)
DUL: Error: While processing ts# 0 file# 1 block# 465020

DUL: Error: Wrong DBA  0X0087187D (file=2, block=465021)
DUL: Error: While processing ts# 0 file# 1 block# 465021

DUL: Error: Wrong DBA  0X0087187E (file=2, block=465022)
DUL: Error: While processing ts# 0 file# 1 block# 465022
```

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至此原因基本定位

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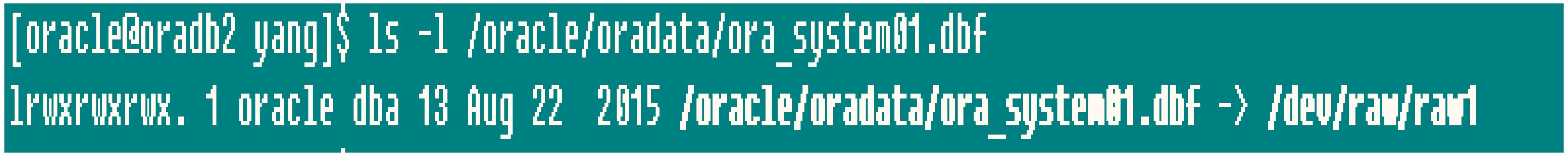
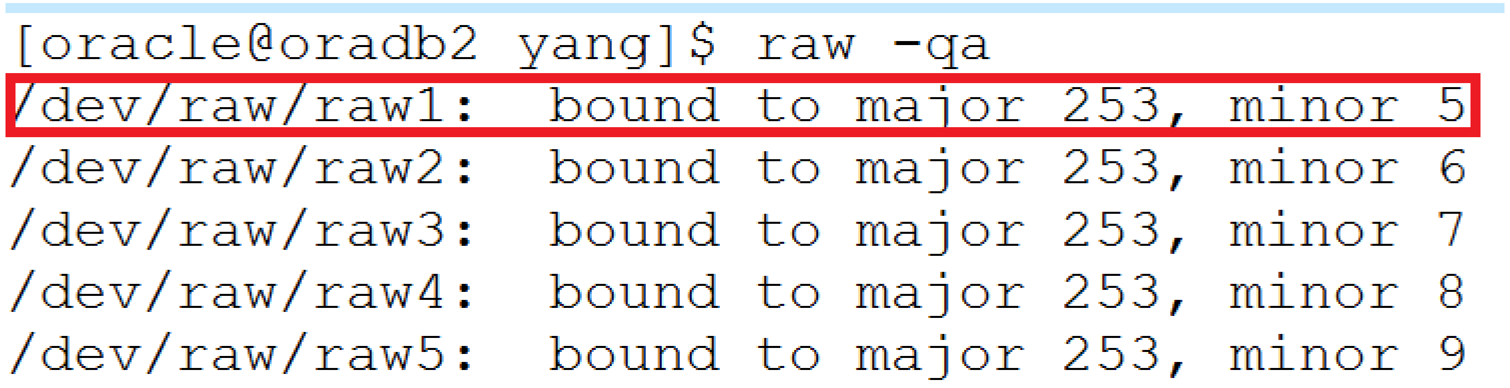
分析过程-梳理数据文件和裸设备的link关系



```
[oracle@oradb2 yang]$ ls -l /oracle/oradata/ora_system01.dbf
lrwxrwxrwx. 1 oracle dba 13 Aug 22  2015 /oracle/oradata/ora_system01.dbf -> /dev/raw/raw1
```

分析过程—梳理裸设备和块设备的映射关系



```
[oracle@oradb2 yang]$ raw -qa
/dev/raw/raw1:  bound to major 253, minor 5
/dev/raw/raw2:  bound to major 253, minor 6
/dev/raw/raw3:  bound to major 253, minor 7
/dev/raw/raw4:  bound to major 253, minor 8
/dev/raw/raw5:  bound to major 253, minor 9
```

分析过程

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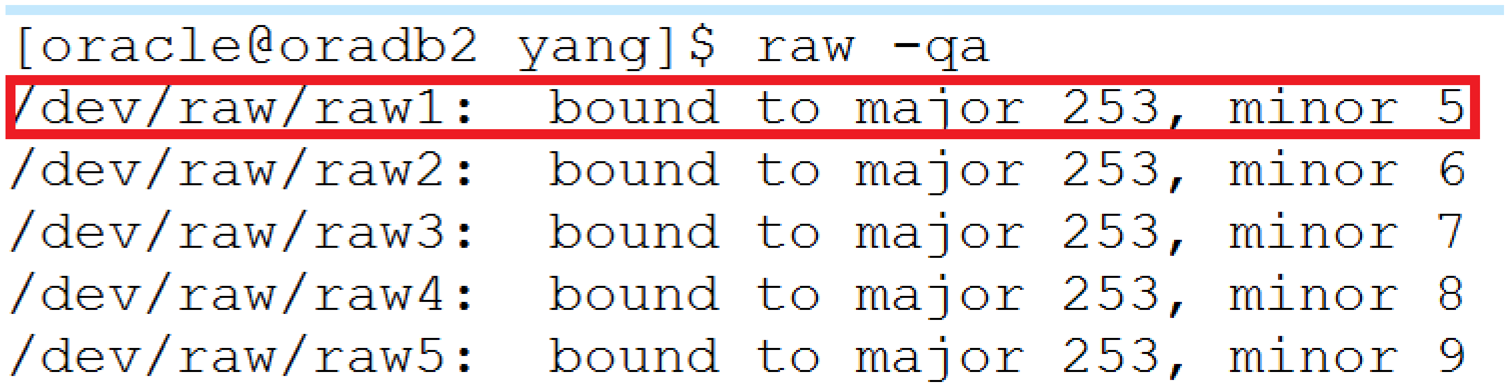
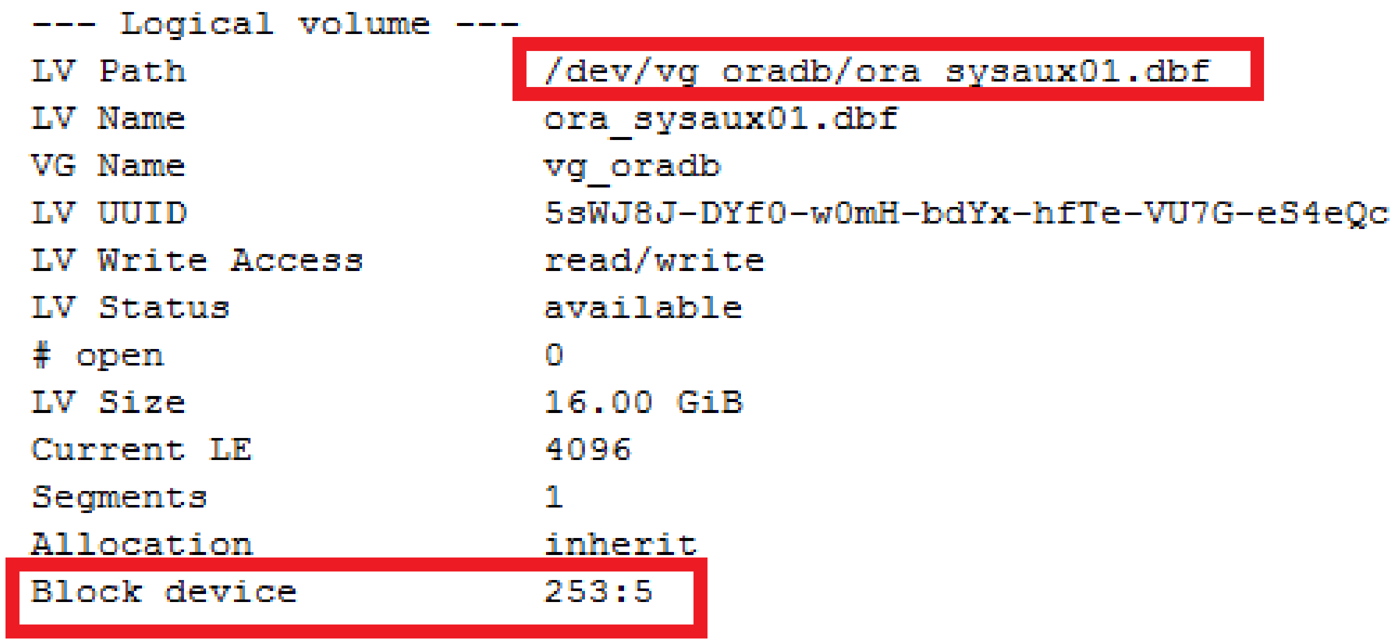


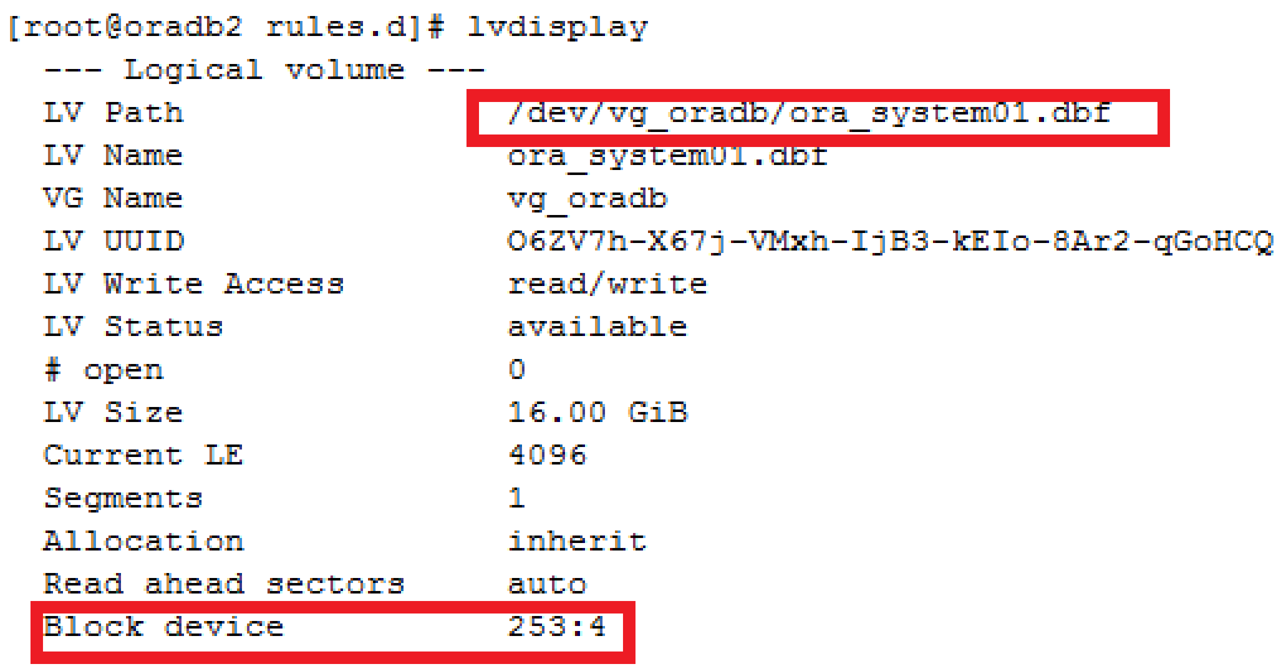
```
[oracle@oradb2 yang]$ raw -qa
/dev/raw/raw1:  bound to major 253, minor 5
/dev/raw/raw2:  bound to major 253, minor 6
/dev/raw/raw3:  bound to major 253, minor 7
/dev/raw/raw4:  bound to major 253, minor 8
/dev/raw/raw5:  bound to major 253, minor 9
```

开始发现异常



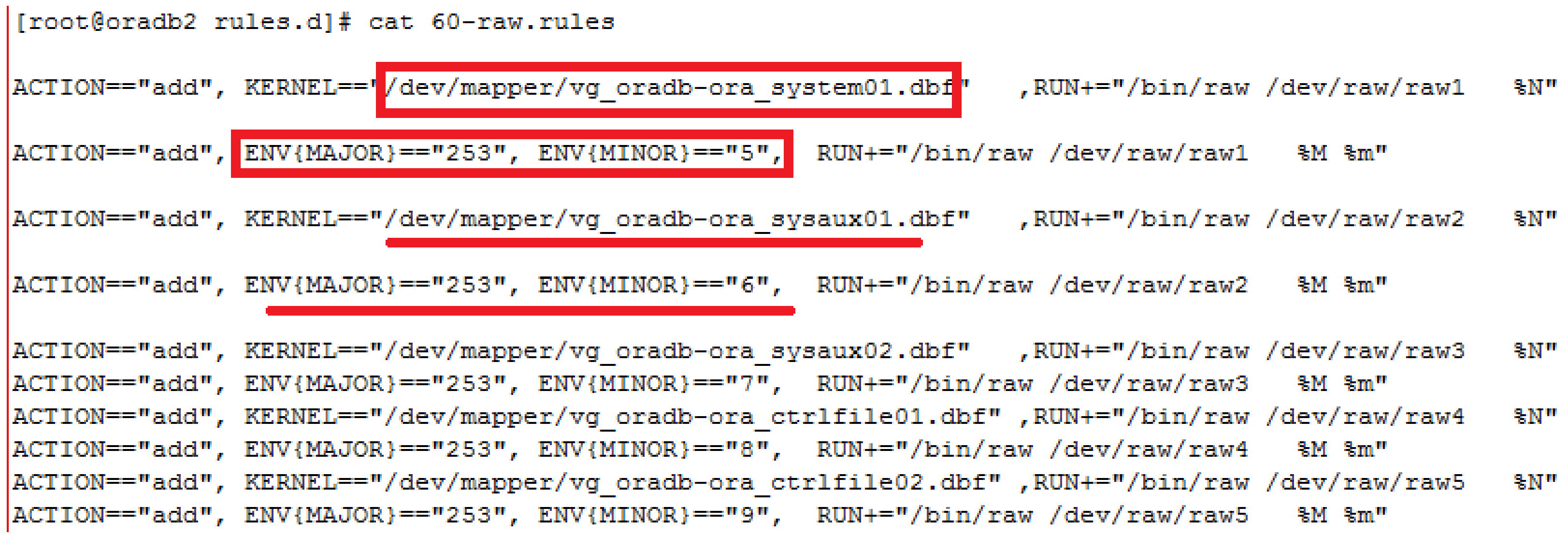
```
--- Logical volume ---
LV Path                /dev/vg_oradb/ora_sysaux01.dbf
LV Name                ora_sysaux01.dbf
VG Name                vg_oradb
LV UUID                5sWJ8J-DYf0-w0mH-bdYx-hfTe-VU7G-eS4eQc
LV Write Access        read/write
LV Status              available
# open                 0
LV Size                16.00 GiB
Current LE             4096
Segments               1
Allocation             inherit
Block device           253:5
```

异常数据（续）



```
[root@oradb2 rules.d]# lvdisplay
  --- Logical volume ---
  LV Path                /dev/vg_oradb/ora_system01.dbf
  LV Name                ora_system01.dbf
  VG Name                vg_oradb
  LV UUID                O6ZV7h-X67j-VMxh-IjB3-kEIo-8Ar2-qGoHCQ
  LV Write Access        read/write
  LV Status              available
  # open                 0
  LV Size                16.00 GiB
  Current LE             4096
  Segments               1
  Allocation             inherit
  Read ahead sectors     auto
  Block device           253:4
```

为什么重启后问题出现



```
[root@oradb2 rules.d]# cat 60-raw.rules

ACTION=="add", KERNEL=="/dev/mapper/vg_oradb-ora_system01.dbf"   ,RUN+="/bin/raw /dev/raw/raw1   %N"

ACTION=="add", ENV{MAJOR}=="253", ENV{MINOR}=="5",  RUN+="/bin/raw /dev/raw/raw1   %M %m"

ACTION=="add", KERNEL=="/dev/mapper/vg_oradb-ora_sysaux01.dbf"   ,RUN+="/bin/raw /dev/raw/raw2   %N"

ACTION=="add", ENV{MAJOR}=="253", ENV{MINOR}=="6",  RUN+="/bin/raw /dev/raw/raw2   %M %m"

ACTION=="add", KERNEL=="/dev/mapper/vg_oradb-ora_sysaux02.dbf"   ,RUN+="/bin/raw /dev/raw/raw3   %N"
ACTION=="add", ENV{MAJOR}=="253", ENV{MINOR}=="7",  RUN+="/bin/raw /dev/raw/raw3   %M %m"
ACTION=="add", KERNEL=="/dev/mapper/vg_oradb-ora_ctrlfile01.dbf" ,RUN+="/bin/raw /dev/raw/raw4   %N"
ACTION=="add", ENV{MAJOR}=="253", ENV{MINOR}=="8",  RUN+="/bin/raw /dev/raw/raw4   %M %m"
ACTION=="add", KERNEL=="/dev/mapper/vg_oradb-ora_ctrlfile02.dbf" ,RUN+="/bin/raw /dev/raw/raw5   %N"
ACTION=="add", ENV{MAJOR}=="253", ENV{MINOR}=="9",  RUN+="/bin/raw /dev/raw/raw5   %M %m"
```

总结和预防

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1、通过根因分析，避免了长时间停机和数据可能不一致的问题

2、如何预防？dataGuard /RAC ？

DBA的未来-Exadata一体机上跑不动的SQL

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客户的邮件

今天早上，同事反映一个问题也有点奇怪，
他说批处理的应用一直挂在那里不往下走。
我看了一下Exadata的数据库，我觉得是应用没有再发起下一步的处理，
所以导致了这个现象，但同事认为是数据库没有返回信息给应用，导致应用那边一直等待。
想问问你怎么看？

客户抓下来的证据

```
select serial#, sql_id, event
  from gv$session
 where sid = 7350;

SERIAL# SQL_ID        EVENT
------- ------------- ------------------------------
  33459 0mss26rs43c7p SQL*Net message from client

......

SERIAL# SQL_ID        EVENT
------- ------------- ------------------------------
  33459 0mss26rs43c7p SQL*Net message from client
```

如果是你，你接下来怎么查？

你亲眼看见的不一定是真实的

```
select to_char(SAMPLE_TIME, 'yyyymmdd hh24:mi:ss') as sample_time,
       event,SESSION_STATE,sql_id
  from dba_hist_active_sess_history
 where SAMPLE_TIME > sysdate - 0.5
   and SESSION_ID = 7350
   and SESSION_SERIAL# = 33459
 order by SAMPLE_TIME

SAMPLE_TIME        EVENT   SESSION SQL_ID
-------------------------------------------
20151221 05:21:34   ON CPU  f5grdjhv2996p
20151221 05:21:44   ON CPU  0mss26rs43c7p
20151221 05:21:54   ON CPU  0mss26rs43c7p
...........
20151221 11:40:11   ON CPU  0mss26rs43c7p
20151221 11:40:21   ON CPU  0mss26rs43c7p
20151221 11:40:31   ON CPU  0mss26rs43c7p
20151221 11:40:41   ON CPU  0mss26rs43c7p
20151221 11:40:51   ON CPU  0mss26rs43c7p
```

执行计划

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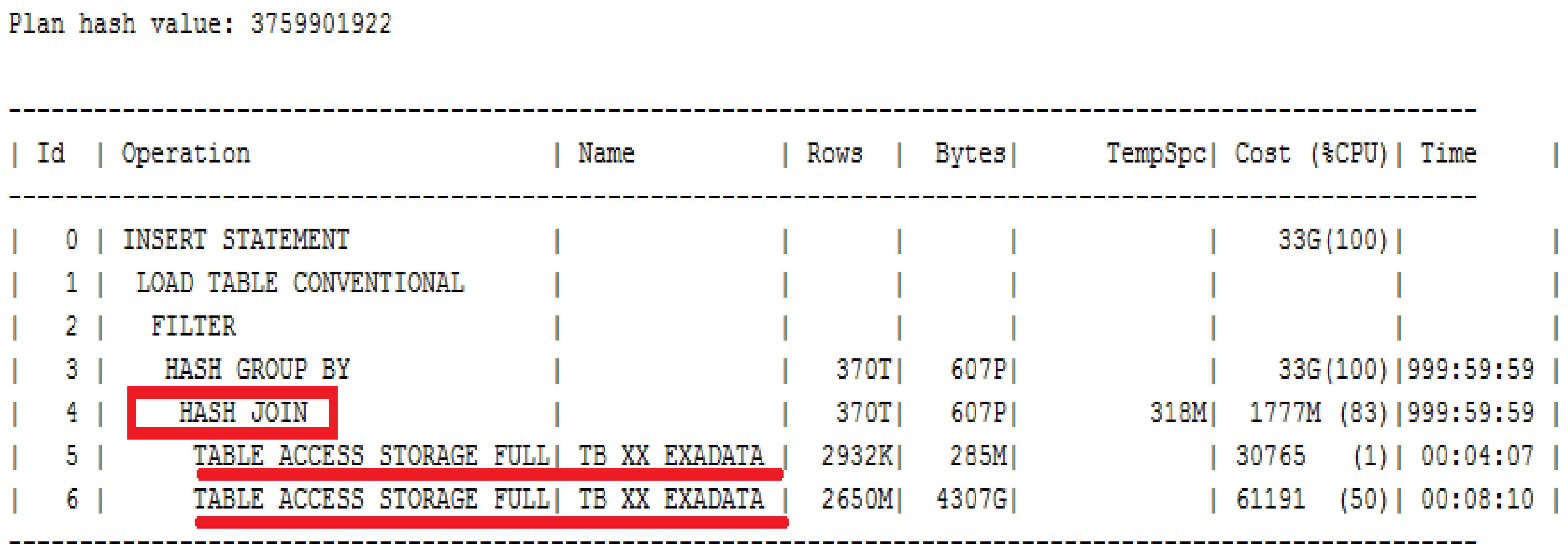

```
Plan hash value: 3759901922

---------------------------------------------------------------------------------------------------
| Id  | Operation                   | Name            | Rows  | Bytes|     TempSpc| Cost (%CPU)| Time     |
---------------------------------------------------------------------------------------------------
|   0 | INSERT STATEMENT            |                 |       |      |            |    33G(100)|          |
|   1 |  LOAD TABLE CONVENTIONAL    |                 |       |      |            |            |          |
|   2 |   FILTER                    |                 |       |      |            |            |          |
|   3 |    HASH GROUP BY            |                 |  370T|   607P|            |    33G(100)|999:59:59 |
|   4 |     HASH JOIN               |                 |  370T|   607P|       318M|  1777M  (83)|999:59:59 |
|   5 |      TABLE ACCESS STORAGE FULL| TB XX EXADATA |  2932K|   285M|            | 30765    (1)| 00:04:07 |
|   6 |      TABLE ACCESS STORAGE FULL| TB XX EXADATA |  2650M|  4307G|            | 61191   (50)| 00:08:10 |
---------------------------------------------------------------------------------------------------
```

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SQL语句

```
INSERT INTO TB_XX_EXADATA_HIS
  (TEMPKEY,
   DATEDT,
   HALFRESULT,
   FCETKEY,
   FCETTYP ECODE,
   FCETNAME,
   ORGANKEY,
   ALERTDESC)
  SELECT t2.TEMPKEY,
         t2.DATEDT,
         t2.HALFRESULT,
         '1102-020603',
         t2.FCETTYPECODE,
         t2.FCET NAME,
         t2.ORGANKEY,
         t2.ALERTDESC
    FROM TB_XX_EXADATA t2,
         (SELECT distinct t.tempkey
            FROM TB_XX_EXADATA t
           GROUP BY t.tempkey
          HAVING count(t.tempkey) >= 10000) t1
   WHERE t2.tempkey = t1.tempkey
```

思考一下什么原因

插播一个案例，你就会明白了☺

案例-突然变慢且再也快不回来的SQL

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问题描述

- 故障现象
  - 应用有一条SQL语句，平时跑10分钟，10月20日起跑10个小时以上。现象可重现
  - 数据量无明显变化
  - 收集统计信息，重启数据库均无法恢复到原来的执行时间
  - 运维DBA和开发均介入，原因未明
- 如果case转到了你手里（你就是运维DBA或开发），你该怎么查
  - 怎么解决
  - 为什么以前不出，而是某一天后开始，以后还会不会再出（领导关心）

完整的SQL语句

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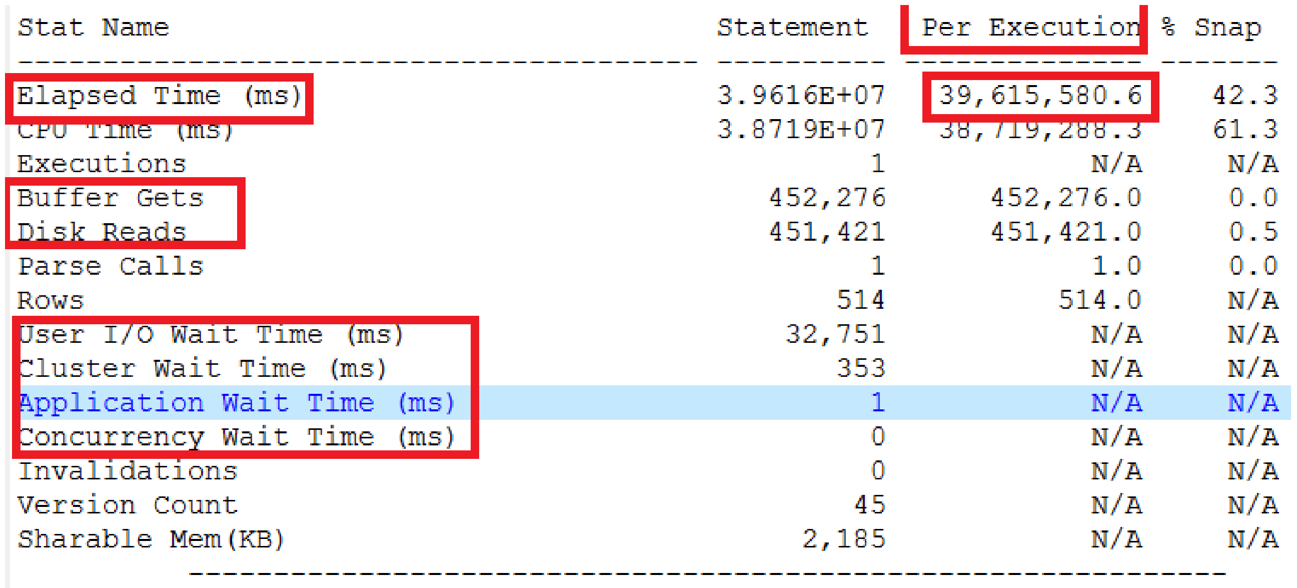
```
SELECT /*+ FULL(SMALL_TABLE) USE_HASH(SMALL_TABLE, BIG_TABLE) */
              BIG_TABLE.COL,
              ......
              SUM(SMALL_TABLE.COL2) SUM1,
              SUM(SMALL_TABLE.COL3) SUM2
  FROM BIG_TABLE     BIG_TABLE, -----3500M，800万
           SMALL_TABLE   SMALL_TABLE  ---80M，160万
 WHERE SMALL_TABLE.ID = BIG_TABLE.ID ----------关联条件
   AND ......
   GROUP BY BIG_TABLE.COL2;
       ...
```

可以看到：两张表张关联，然后group by
SQL语句用了hint(告诉数据库，走什么样的执行计划)

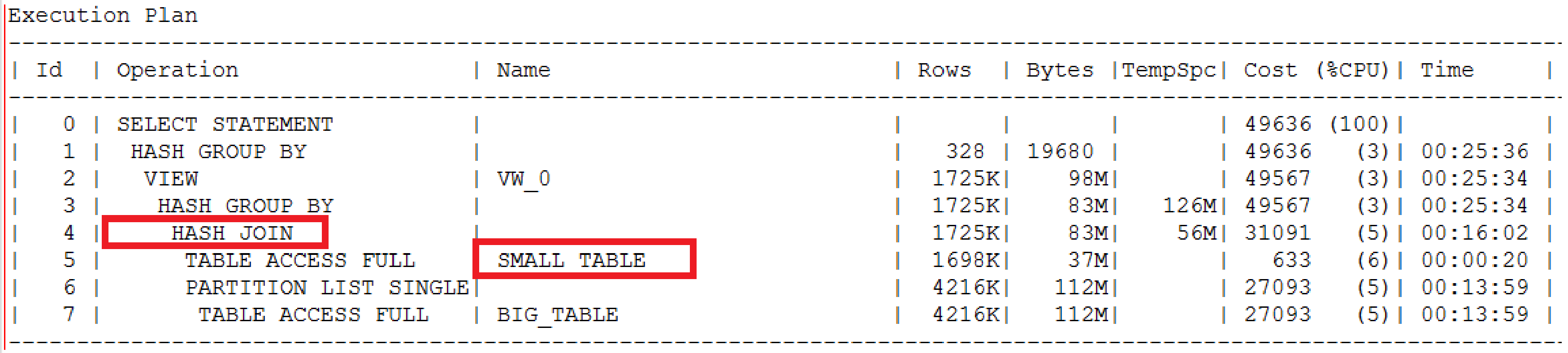
SQL执行的相关统计



```
Stat Name                                Statement   Per Execution % Snap
---------------------------------------- ----------- -------------- -------
Elapsed Time (ms)                        3.9616E+07   39,615,580.6    42.3
CPU Time (ms)                            3.8719E+07   38,719,288.3    61.3
Executions                                        1            N/A     N/A
Buffer Gets                                 452,276      452,276.0     0.0
Disk Reads                                  451,421      451,421.0     0.5
Parse Calls                                       1            1.0     0.0
Rows                                            514          514.0     N/A
User I/O Wait Time (ms)                      32,751            N/A     N/A
Cluster Wait Time (ms)                          353            N/A     N/A
Application Wait Time (ms)                        1            N/A     N/A
Concurrency Wait Time (ms)                        0            N/A     N/A
Invalidations                                     0            N/A     N/A
Version Count                                    45            N/A     N/A
Sharable Mem(KB)                              2,185            N/A     N/A
          -------------------------------------------------------------
```

每次执行时间39，615秒
每次执行逻辑读45，276个block(块)
每次执行物理读451421个block(块)
时间基本都消耗在CPU上，而在IO/集群/应用（锁）/并发环节基本没有发生什么等待事件，消耗时间很小

执行计划



```
Execution Plan
-------------------------------------------------------------------------------------------------------------------------
| Id  | Operation                     | Name                           | Rows  | Bytes |TempSpc| Cost (%CPU)| Time     |
-------------------------------------------------------------------------------------------------------------------------
|   0 | SELECT STATEMENT              |                                |       |       |       | 49636 (100)|          |
|   1 |  HASH GROUP BY                |                                |   328 | 19680 |       | 49636   (3)| 00:25:36 |
|   2 |   VIEW                        | VW_0                           | 1725K|    98M|       | 49567   (3)| 00:25:34 |
|   3 |    HASH GROUP BY              |                                | 1725K|    83M|   126M| 49567   (3)| 00:25:34 |
|   4 |     HASH JOIN                 |                                | 1725K|    83M|    56M| 31091   (5)| 00:16:02 |
|   5 |      TABLE ACCESS FULL        | SMALL TABLE                    | 1698K|    37M|       |   633   (6)| 00:00:20 |
|   6 |      PARTITION LIST SINGLE    |                                | 4216K|   112M|       | 27093   (5)| 00:13:59 |
|   7 |       TABLE ACCESS FULL       | BIG_TABLE                      | 4216K|   112M|       | 27093   (5)| 00:13:59 |
-------------------------------------------------------------------------------------------------------------------------
```

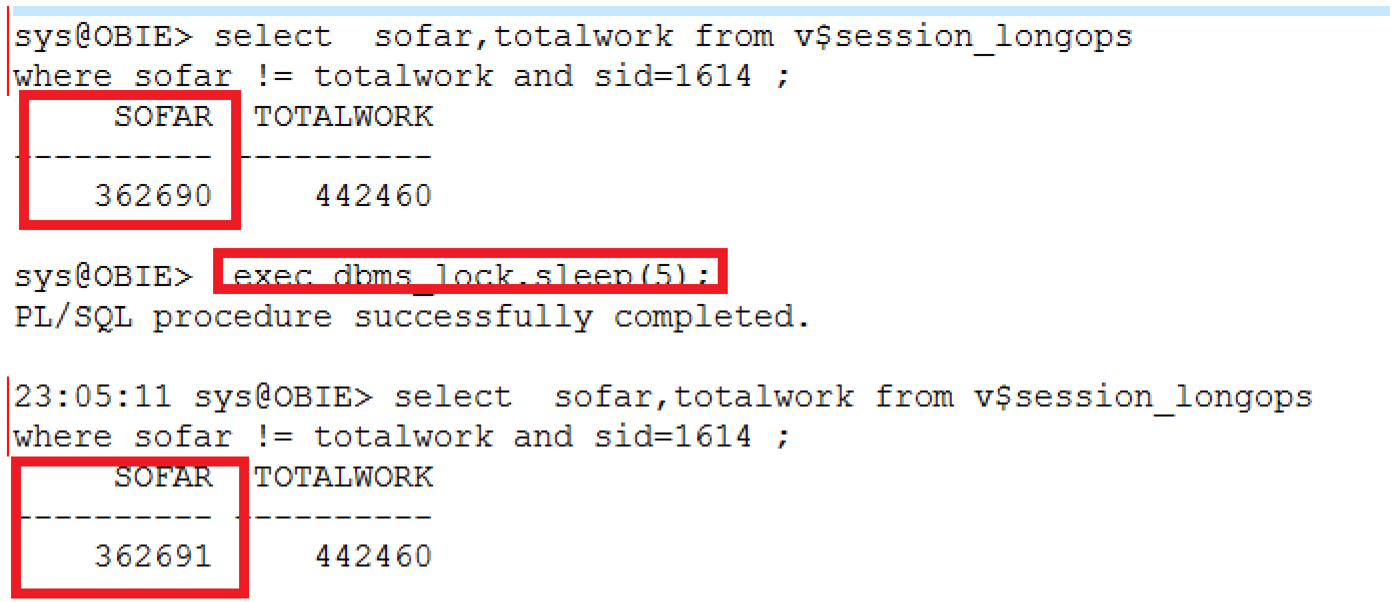
可以看到，执行计划（oracle内部的算法）确实如hint一样

表连接方式走的是hash join

单表访问路径都是全表扫描(table access full)

表连接顺序是小表做驱动表(hash内存表）

其他线索1



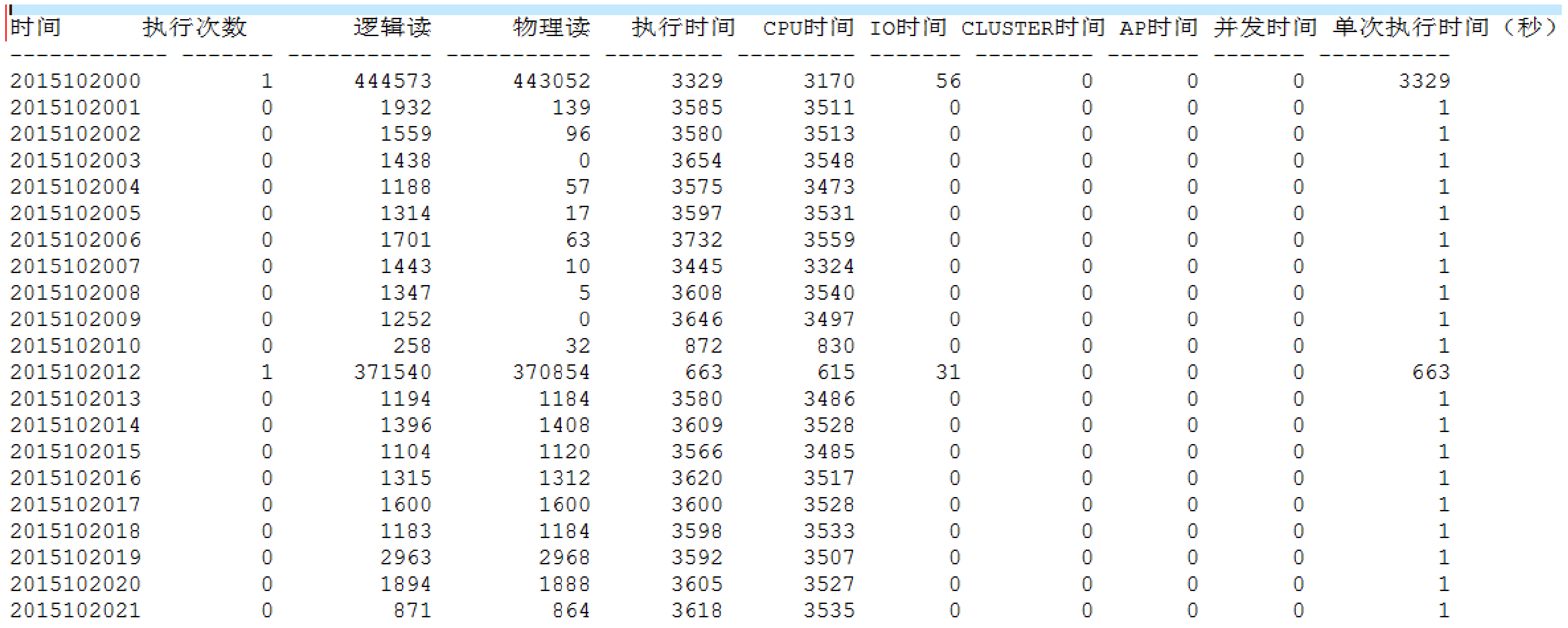
```
sys@OBIE> select  sofar,totalwork from v$session_longops
where sofar != totalwork and sid=1614 ;
     SOFAR  TOTALWORK
---------- ----------
    362690     442460

sys@OBIE> exec dbms_lock.sleep(5);
PL/SQL procedure successfully completed.

23:05:11 sys@OBIE> select  sofar,totalwork from v$session_longops
where sofar != totalwork and sid=1614 ;
     SOFAR  TOTALWORK
---------- ----------
    362691     442460
```

- v$session_longops中表SMALL_TABLE已经扫描完成 100%
- 但另外一张表BIG_TABLE全表扫描的进度进本停留在82%，查看，发现每5秒才1个块

其他线索2-历史执行统计



```
时间          执行次数         逻辑读        物理读     执行时间    CPU时间  IO时间 CLUSTER时间 AP时间 并发时间 单次执行时间（秒）
------------ -------- ------------ ------------ ---------- ---------- ------- ---------- ------- ------- ----------
2015102000          1       444573       443052       3329       3170      56          0       0       0       3329
2015102001          0         1932          139       3585       3511       0          0       0       0          1
2015102002          0         1559           96       3580       3513       0          0       0       0          1
2015102003          0         1438            0       3654       3548       0          0       0       0          1
2015102004          0         1188           57       3575       3473       0          0       0       0          1
2015102005          0         1314           17       3597       3531       0          0       0       0          1
2015102006          0         1701           63       3732       3559       0          0       0       0          1
2015102007          0         1443           10       3445       3324       0          0       0       0          1
2015102008          0         1347            5       3608       3540       0          0       0       0          1
2015102009          0         1252            0       3646       3497       0          0       0       0          1
2015102010          0          258           32        872        830       0          0       0       0          1
2015102012          1       371540       370854        663        615      31          0       0       0        663
2015102013          0         1194         1184       3580       3486       0          0       0       0          1
2015102014          0         1396         1408       3609       3528       0          0       0       0          1
2015102015          0         1104         1120       3566       3485       0          0       0       0          1
2015102016          0         1315         1312       3620       3517       0          0       0       0          1
2015102017          0         1600         1600       3600       3528       0          0       0       0          1
2015102018          0         1183         1184       3598       3533       0          0       0       0          1
2015102019          0         2963         2968       3592       3507       0          0       0       0          1
2015102020          0         1894         1888       3605       3527       0          0       0       0          1
2015102021          0          871          864       3618       3535       0          0       0       0          1
```

- 每个小时才处理1000-3000的逻辑读
- 一开始快，后来慢
- 时间都在CPU上

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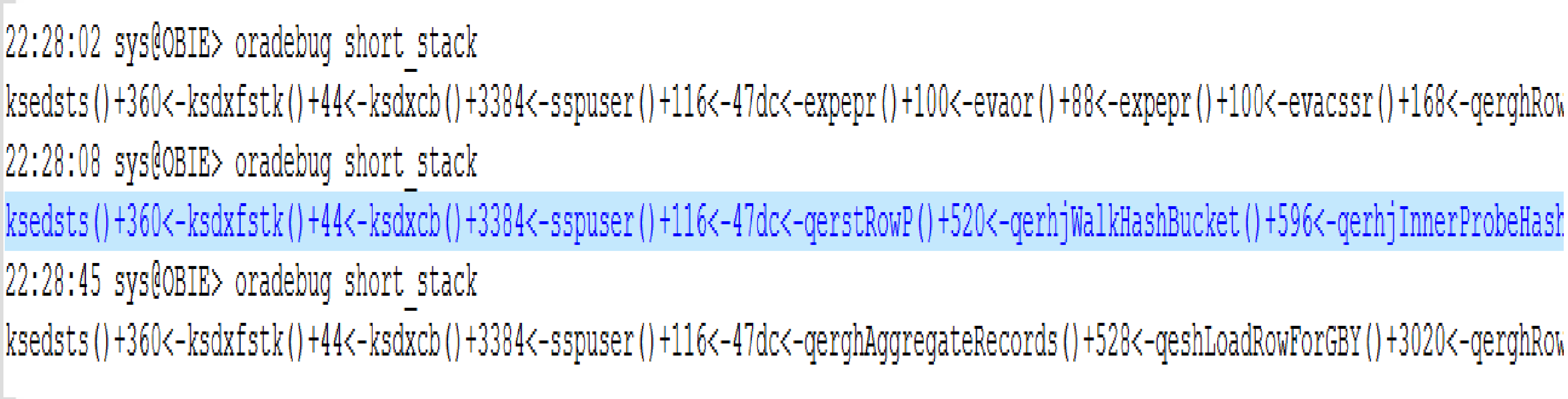
其他线索3-CallStack



```
22:28:02 sys@OBIE> oradebug short_stack
ksedsts()+360<-ksdxfstk()+44<-ksdxcb()+3384<-sspuser()+116<-47dc<-expepr()+100<-evaor()+88<-expepr()+100<-evacssr()+168<-qerghRow
22:28:08 sys@OBIE> oradebug short_stack
ksedsts()+360<-ksdxfstk()+44<-ksdxcb()+3384<-sspuser()+116<-47dc<-qerstRowP()+520<-qerhjWalkHashBucket()+596<-qerhjInnerProbeHash
22:28:45 sys@OBIE> oradebug short_stack
ksedsts()+360<-ksdxfstk()+44<-ksdxcb()+3384<-sspuser()+116<-47dc<-qerghAggregateRecords()+528<-qeshLoadRowForGBY()+3020<-qerghRow
```

思考原因

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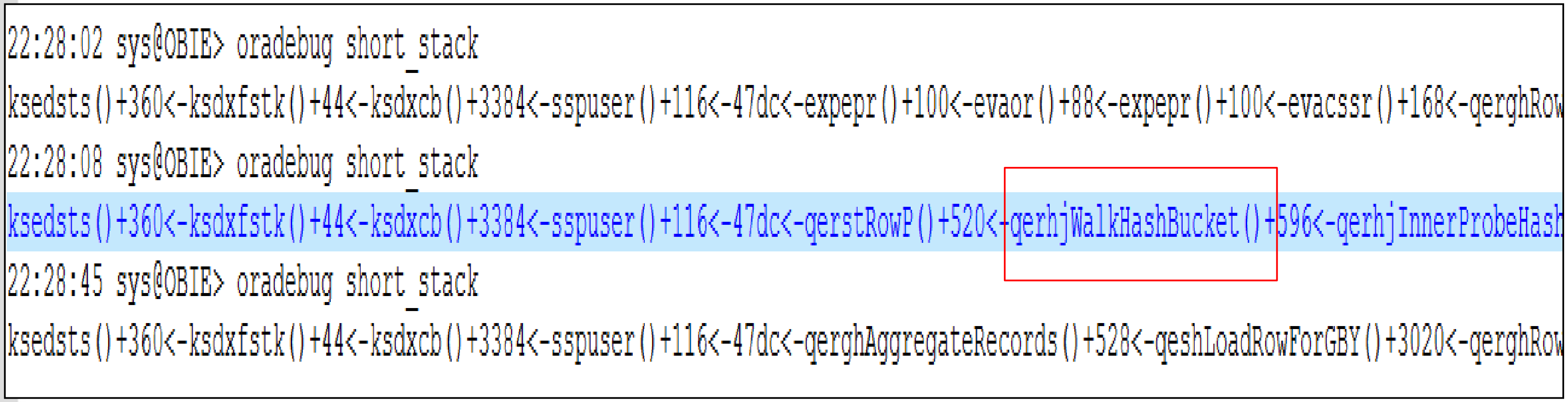
综合所有现象，得到线索，定位原因

CallStack



```
22:28:02 sys@OBIE> oradebug short_stack
ksedsts()+360<-ksdxfstk()+44<-ksdxcb()+3384<-sspuser()+116<-47dc<-expepr()+100<-evaor()+88<-expepr()+100<-evacssr()+168<-qerghRow
22:28:08 sys@OBIE> oradebug short_stack
ksedsts()+360<-ksdxfstk()+44<-ksdxcb()+3384<-sspuser()+116<-47dc<-qerstRowP()+520<-qerhjWalkHashBucket()+596<-qerhjInnerProbeHash
22:28:45 sys@OBIE> oradebug short_stack
ksedsts()+360<-ksdxfstk()+44<-ksdxcb()+3384<-sspuser()+116<-47dc<-qerghAggregateRecords()+528<-qeshLoadRowForGBY()+3020<-qerghRow
```

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Hash Join原理

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SELECT * FROM A,B
WHERE A.ID=B.ID

1) SCAN A
2) HASH(A.ID),打散到各个桶（BUCKET）中，呆在pga hash area中等待别人来匹配
3) SCAN B
4) HASH(B.ID)
5) 到相应的Bucket中，比较表关联字段，返回或丢弃

HASH的目的是为了打算数据到各个桶中
那么HASH JOIN有什么缺点呢？
我们是否命中了该缺点？！

验证分析

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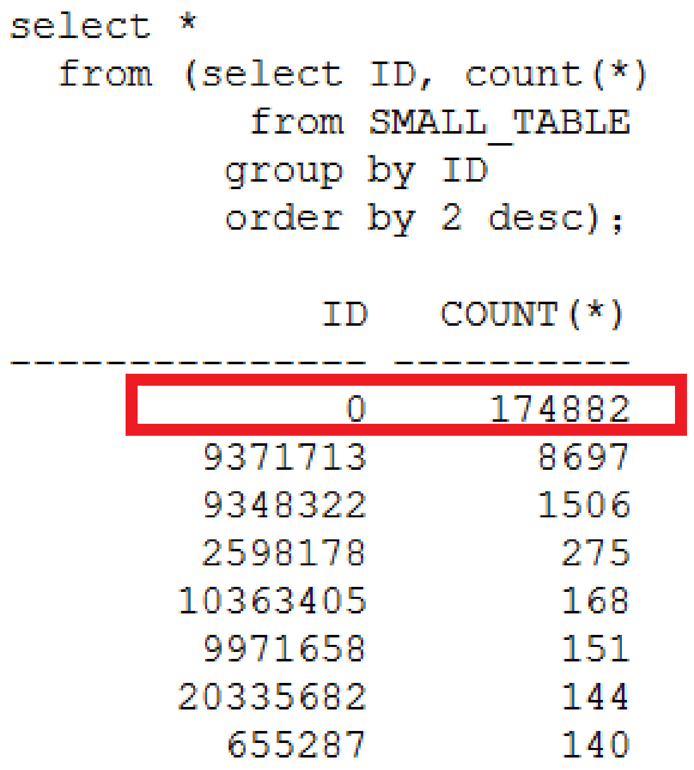
Hash 内存表（驱动表）表关联字段分布不均



```
select *
  from (select ID, count(*)
          from SMALL_TABLE
         group by ID
         order by 2 desc);

             ID   COUNT(*)
--------------- ----------
              0     174882
        9371713       8697
        9348322       1506
        2598178        275
       10363405        168
        9971658        151
       20335682        144
         655287        140
```

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进一步验证Hash Join的缺点

```
SELECT /*+ FULL(SMALL_TABLE) USE_HASH(SMALL_TABLE, BIG_TABLE) */
             BIG_TABLE.COL,
             ……
             SUM(SMALL_TABLE.COL2) SUM1,
             SUM(SMALL_TABLE.COL3) SUM2
  FROM BIG_TABLE     BIG_TABLE, -----3500M，800万
            SMALL_TABLE   SMALL_TABLE  ---80M，160万
 WHERE SMALL_TABLE.ID = BIG_TABLE.ID ----------关联条件
   AND ……
   AND SMALL_TABLE.ID != 0
   GROUP BY BIG_TABLE.COL2;
         …
```

经验提示

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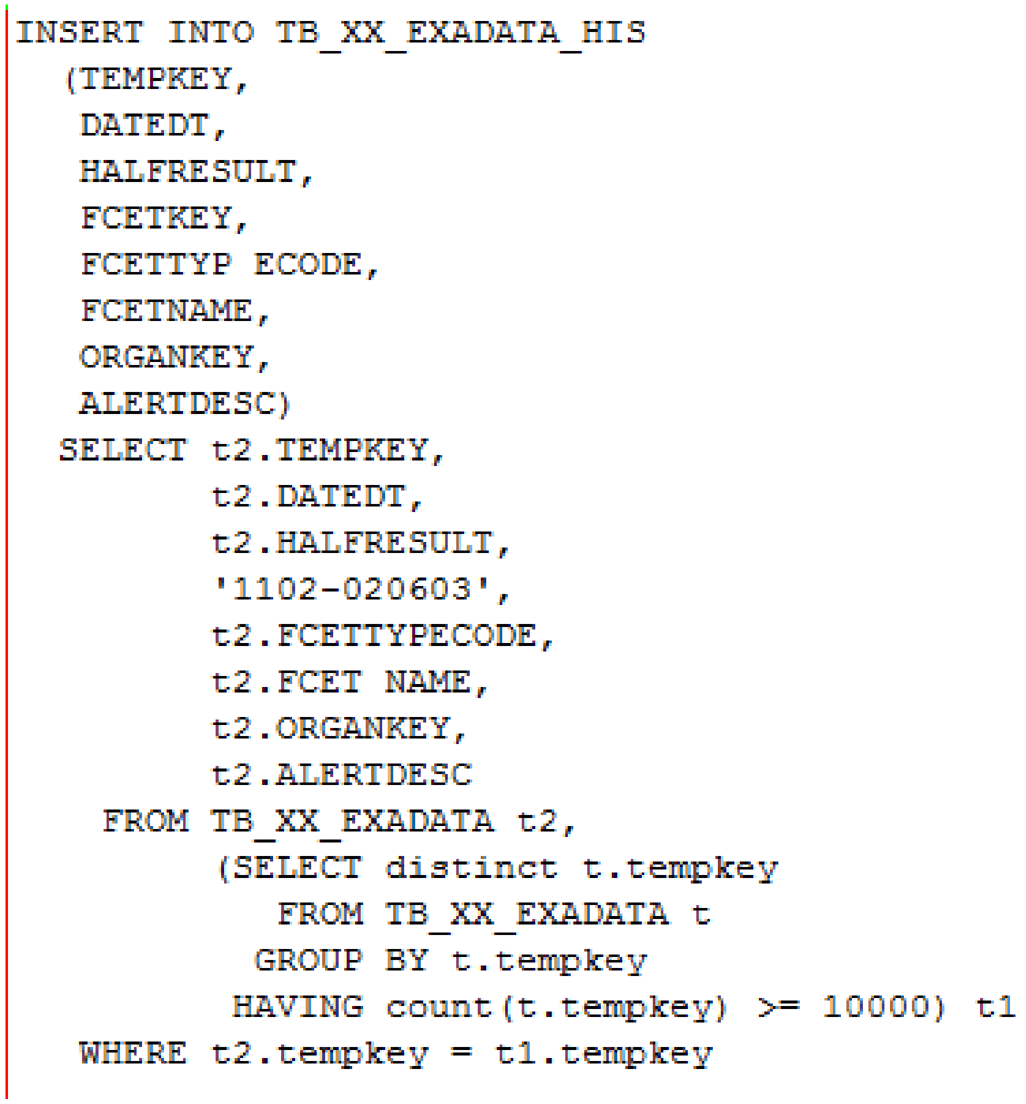
◆掌握原理是必须的

◆什么样的架构/存储结构决定了他可以做什么样的事情，不可以做什么样的事情

◆但你思考过他的缺点是什么么？以前没有？建议尝试，让你有更多收获

回到上一个案例再来看原因

SQL语句



```
INSERT INTO TB_XX_EXADATA_HIS
  (TEMPKEY,
   DATEDT,
   HALFRESULT,
   FCETKEY,
   FCETTYP ECODE,
   FCETNAME,
   ORGANKEY,
   ALERTDESC)
  SELECT t2.TEMPKEY,
         t2.DATEDT,
         t2.HALFRESULT,
         '1102-020603',
         t2.FCETTYPECODE,
         t2.FCET NAME,
         t2.ORGANKEY,
         t2.ALERTDESC
    FROM TB_XX_EXADATA t2,
         (SELECT distinct t.tempkey
            FROM TB_XX_EXADATA t
           GROUP BY t.tempkey
          HAVING count(t.tempkey) >= 10000) t1
   WHERE t2.tempkey = t1.tempkey
```

执行计划

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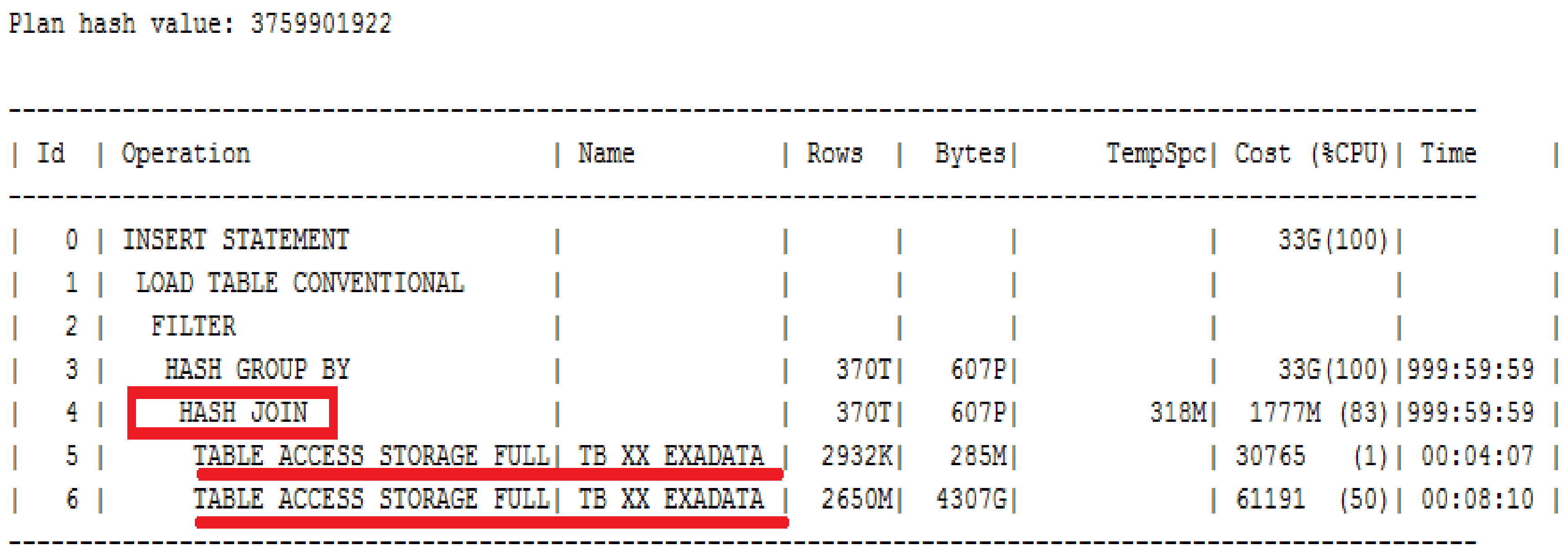

```
Plan hash value: 3759901922

-----------------------------------------------------------------------------------------------------
| Id  | Operation                      | Name           | Rows  | Bytes|      TempSpc| Cost (%CPU)| Time     |
-----------------------------------------------------------------------------------------------------
|   0 | INSERT STATEMENT               |                |       |      |             |    33G(100)|          |
|   1 |  LOAD TABLE CONVENTIONAL       |                |       |      |             |            |          |
|   2 |   FILTER                       |                |       |      |             |            |          |
|   3 |    HASH GROUP BY               |                |  370T|   607P|             |    33G(100)|999:59:59 |
|   4 |     HASH JOIN                  |                |  370T|   607P|         318M|  1777M (83)|999:59:59 |
|   5 |      TABLE ACCESS STORAGE FULL| TB XX EXADATA |  2932K|   285M|             | 30765   (1)| 00:04:07 |
|   6 |      TABLE ACCESS STORAGE FULL| TB XX EXADATA |  2650M|  4307G|             | 61191  (50)| 00:08:10 |
-----------------------------------------------------------------------------------------------------
```

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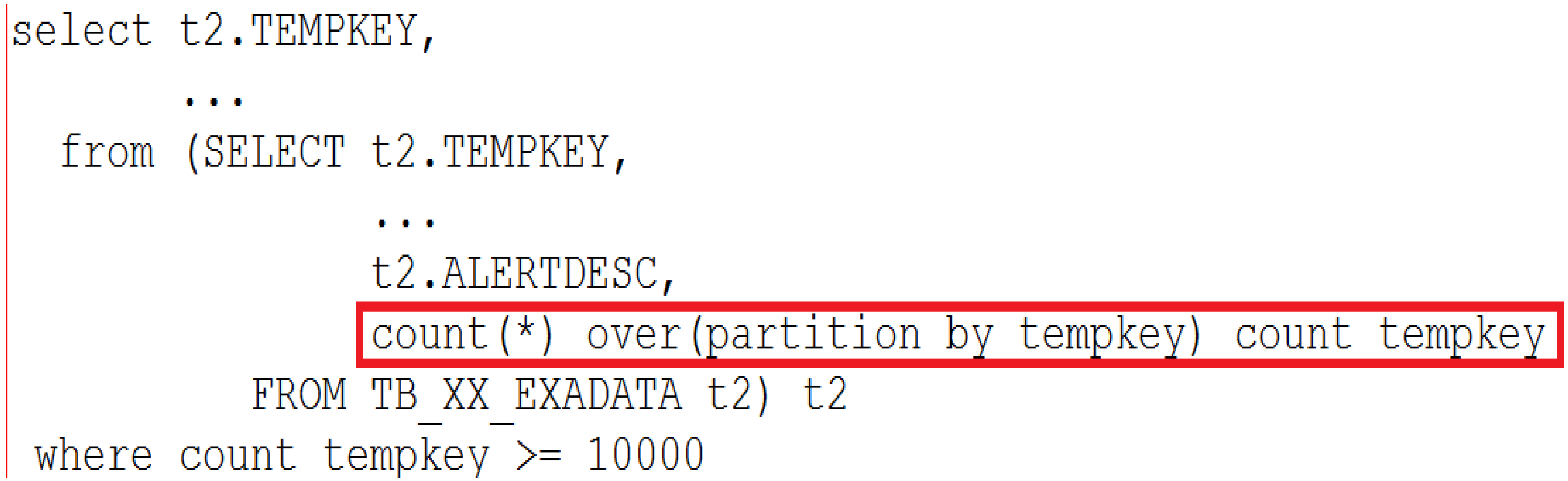
原因和解决之道

原因，不用说了吧，刚刚讲完。本质是一个事
可以在inline view中加入no_merge的hint
进一步的可以用分析函数来优化，参考语法如下



```
select t2.TEMPKEY,
       ...
  from (SELECT t2.TEMPKEY,
               ...
               t2.ALERTDESC,
               count(*) over(partition by tempkey) count tempkey
          FROM TB_XX_EXADATA t2) t2
 where count tempkey >= 10000
```

下一个案例

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优化案例-执行计划选错索引和驱动表

```
-------------------------------------------------------------------------------------------------------------------------
| Id  | Operation                                | Name                | Rows  | Bytes | Cost  | Time        | Pstart|
-------------------------------------------------------------------------------------------------------------------------
| 0   | SELECT STATEMENT                         |                     |       |       |    13 |             |       |
| 1   |  SORT GROUP BY                           |                     |     1 |   229 |       |             |       |
| 2   |   FILTER                                 |                     |       |       |       |             |       |
| 3   |    NESTED LOOPS OUTER                    |                     |     1 |   229 |    13 |  00:00:01   |       |
| 4   |     NESTED LOOPS                         |                     |     1 |   195 |    10 |  00:00:01   |       |
| 5   |      NESTED LOOPS OUTER                  |                     |     1 |   159 |     8 |  00:00:01   |       |
| 6   |       NESTED LOOPS OUTER                 |                     |     1 |   130 |     6 |  00:00:01   |       |
| 7   |        TABLE ACCESS BY INDEX ROWID       | TBL_CP_CREATE       |     1 |   101 |     4 |  00:00:01   |       |
| 8   |         INDEX RANGE SCAN                 | CP_CREATETIME_IDX   |     1 |       |     3 |  00:00:01   |       |
| 9   |        INDEX RANGE SCAN                  | CP_DRAFT_IDX        |     1 |    29 |     2 |  00:00:01   |       |
| 10  |       INDEX RANGE SCAN                   | KFVISITDRAFTID      |     1 |    29 |     2 |  00:00:01   |       |
| 11  |      TABLE ACCESS BY GLOBAL INDEX ROWID  | TBL_CP_BILLSTATEMAP|     1 |    36 |     2 |  00:00:01   | ROW LOC
| 12  |       INDEX UNIQUE SCAN                  | SYS_C0034056        |     1 |       |     1 |  00:00:01   |       |
| 13  |     TABLE ACCESS BY INDEX ROWID          | TBL_CP_CREATE_USER  |     1 |    34 |     3 |  00:00:01   |       |
| 14  |      INDEX RANGE SCAN                    | CP_CREATINFOID_IDX  |     1 |       |     2 |  00:00:01   |       |
-------------------------------------------------------------------------------------------------------------------------

Predicate Information:
-------------------------------------------------------------------------------------------------------------------------
2 - filter(("TS_CREATE"."LOCATION"='0579' OR "T_USER"."LOCATION"='0579'))
8 - access("TS_CREATE"."CREATETIME">='2015-06-23 00:00:00' AND "TS_CREATE"."CREATETIME"<='2015-09-21 23:59:59')
9 - access("TS_CREATE"."DRAFTID"="ACCEPT"."DRAFTID")
10 - access("TS_KFBACK"."DRAFTID"="TS_CREATE"."DRAFTID")
11 - filter("TS_MAP"."BILLSTATE"='待报结')
```

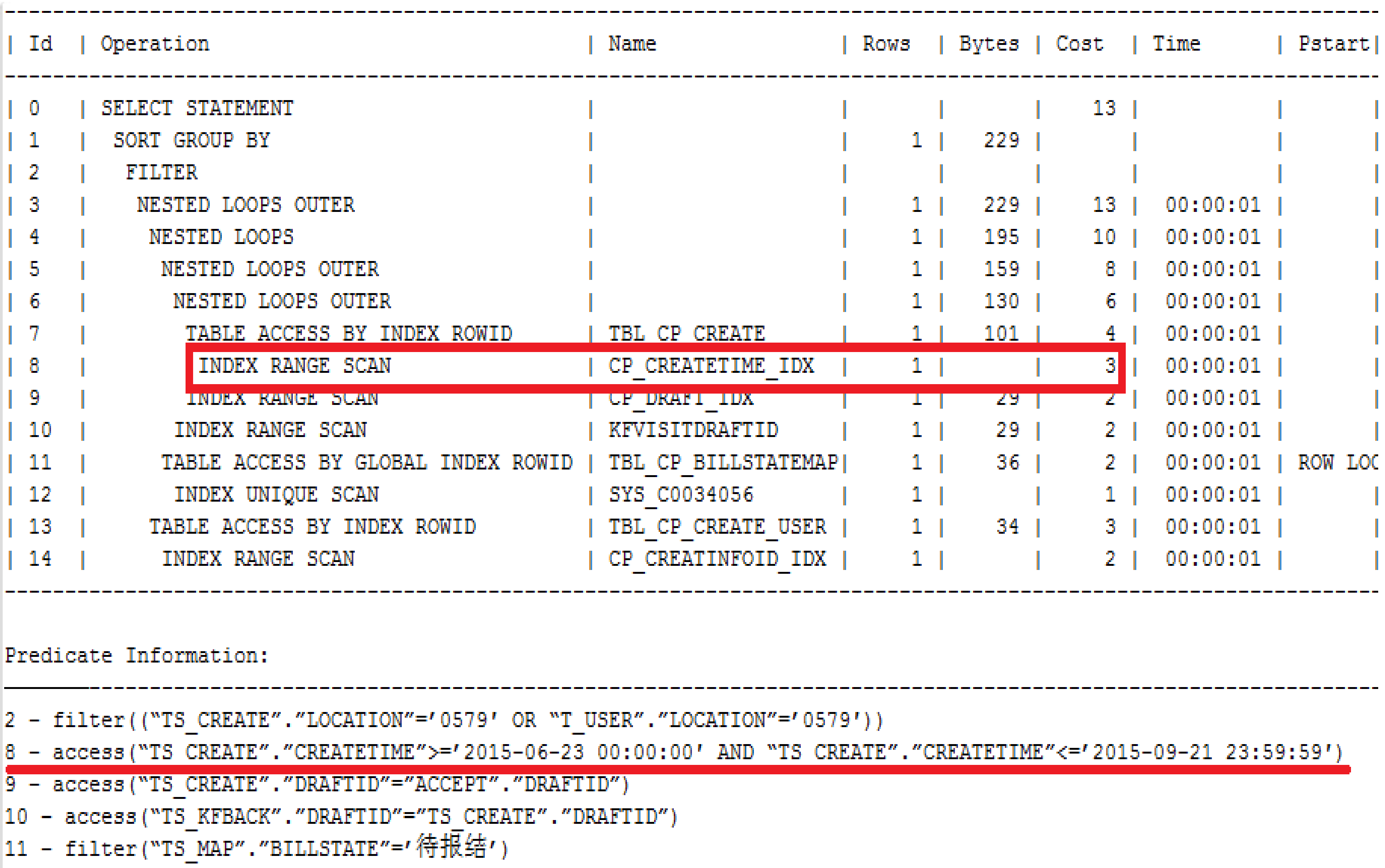
问题在哪？如何解决？

1、看不出问题就是最大的问题

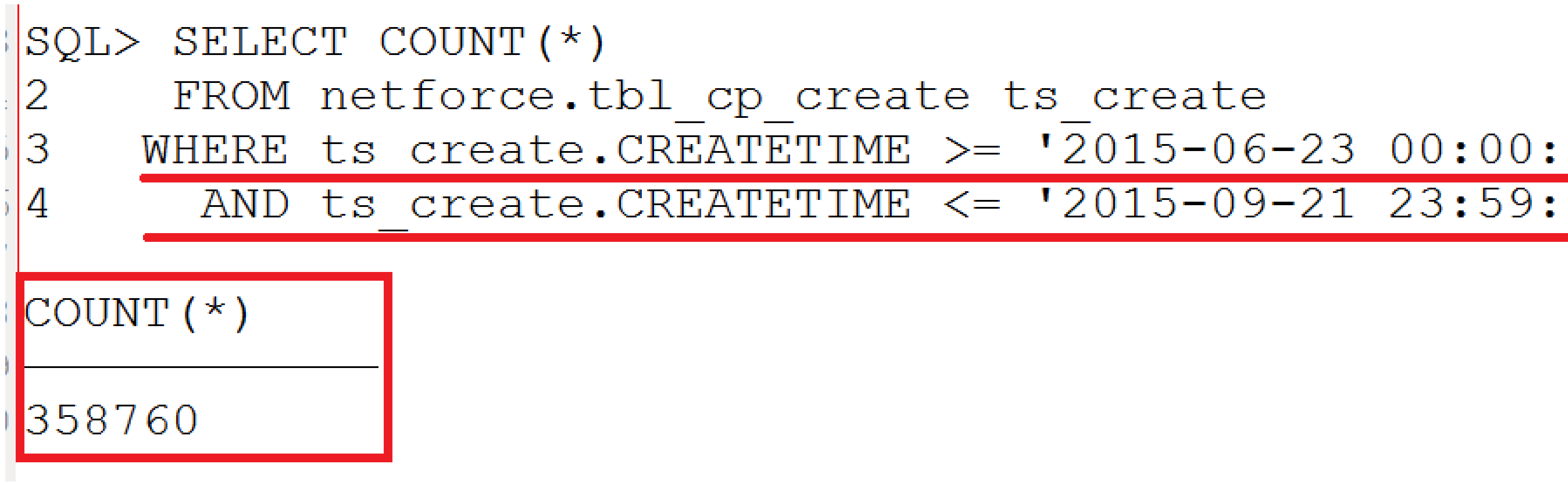
2、统计信息不对?
检查统计信息是相对准确的!
收集后问题依然！执行计划和COST和原来一样!

3、加hint或绑定执行计划?
找不到问题原因，如何去做到由点带面和预防类似问题呢？只能头痛医头！永远只能事后去绑定执行计划，而不能从根本上预防同类问题!

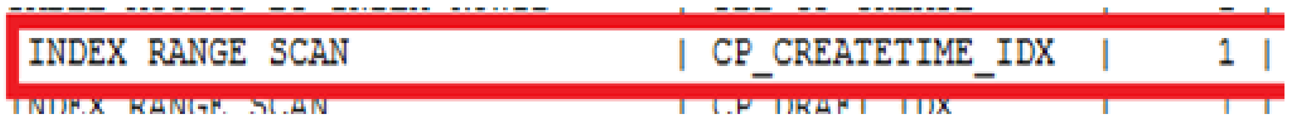
其实分析执行计划可以很快！



```
-------------------------------------------------------------------------------------------------------------
| Id  | Operation                            | Name                | Rows  | Bytes | Cost  | Time       | Pstart|
-------------------------------------------------------------------------------------------------------------
| 0   | SELECT STATEMENT                     |                     |       |       |    13 |            |       |
| 1   |  SORT GROUP BY                       |                     |     1 |   229 |       |            |       |
| 2   |   FILTER                             |                     |       |       |       |            |       |
| 3   |    NESTED LOOPS OUTER                |                     |     1 |   229 |    13 |  00:00:01  |       |
| 4   |     NESTED LOOPS                     |                     |     1 |   195 |    10 |  00:00:01  |       |
| 5   |      NESTED LOOPS OUTER              |                     |     1 |   159 |     8 |  00:00:01  |       |
| 6   |       NESTED LOOPS OUTER             |                     |     1 |   130 |     6 |  00:00:01  |       |
| 7   |        TABLE ACCESS BY INDEX ROWID   | TBL_CP_CREATE       |     1 |   101 |     4 |  00:00:01  |       |
| 8   |         INDEX RANGE SCAN             | CP_CREATETIME_IDX   |     1 |       |     3 |  00:00:01  |       |
| 9   |        INDEX RANGE SCAN              | CP_DRAFT_IDX        |     1 |    29 |     2 |  00:00:01  |       |
| 10  |        INDEX RANGE SCAN              | KFVISITDRAFTID      |     1 |    29 |     2 |  00:00:01  |       |
| 11  |       TABLE ACCESS BY GLOBAL INDEX ROWID | TBL_CP_BILLSTATEMAP|   1 |    36 |     2 |  00:00:01  | ROW LOC
| 12  |        INDEX UNIQUE SCAN             | SYS_C0034056        |     1 |       |     1 |  00:00:01  |       |
| 13  |      TABLE ACCESS BY INDEX ROWID     | TBL_CP_CREATE_USER  |     1 |    34 |     3 |  00:00:01  |       |
| 14  |       INDEX RANGE SCAN               | CP_CREATINFOID_IDX  |     1 |       |     2 |  00:00:01  |       |
-------------------------------------------------------------------------------------------------------------

Predicate Information:
-------------------------------------------------------------------------------------------------------------
2 - filter(("TS_CREATE"."LOCATION"='0579' OR "T_USER"."LOCATION"='0579'))
8 - access("TS_CREATE"."CREATETIME">='2015-06-23 00:00:00' AND "TS_CREATE"."CREATETIME"<='2015-09-21 23:59:59')
9 - access("TS_CREATE"."DRAFTID"="ACCEPT"."DRAFTID")
10 - access("TS_KFBACK"."DRAFTID"="TS_CREATE"."DRAFTID")
11 - filter("TS_MAP"."BILLSTATE"='待报结')
```



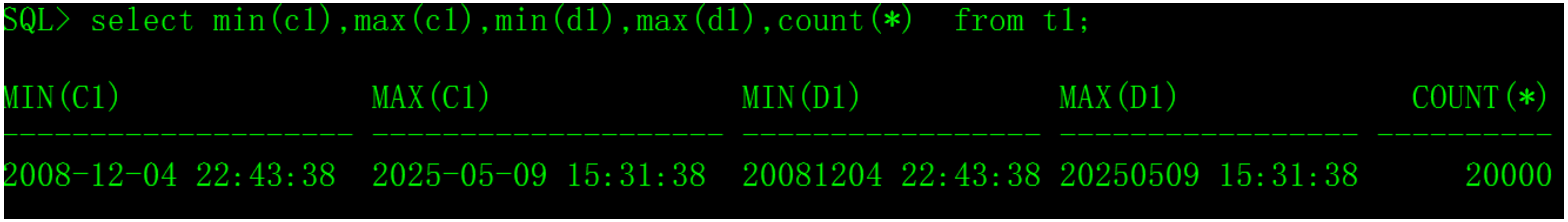
```
SQL> SELECT COUNT(*)
2      FROM netforce.tbl_cp_create ts_create
3     WHERE ts_create.CREATETIME >= '2015-06-23 00:00:
4      AND ts_create.CREATETIME <= '2015-09-21 23:59:

COUNT(*)
------------
358760
```



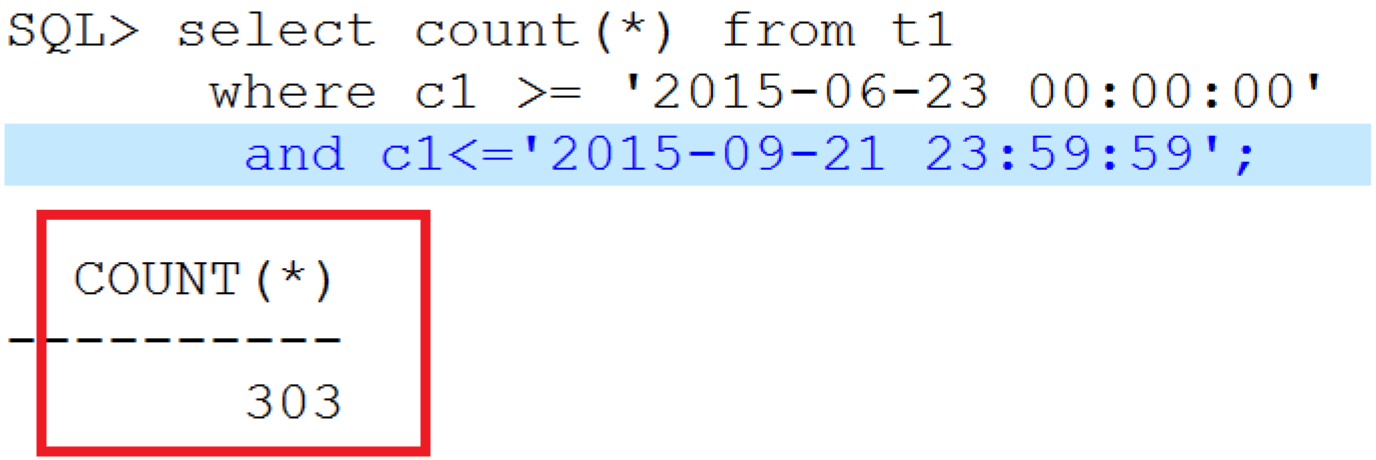
```
INDEX RANGE SCAN                | CP_CREATETIME_IDX   |      1 |
INDEX RANGE SCAN                | CP_DRAFT_IDX        |        |
```

我们来重现下问题

```
drop table t2;

create table t2(d1 date, c1 varchar2(20));

declare
  v date;
begin
  v := to_date('2008-12-04 22:43:38', 'yyyy-mm-dd hh24:mi:ss');
  for i in 1 .. 20000 loop
    insert into t2 values (v, to_char(v, 'yyyy-mm-dd hh24:mi:ss'));
    v := v + 0.3;
  end loop;
  commit;
end;
/
```

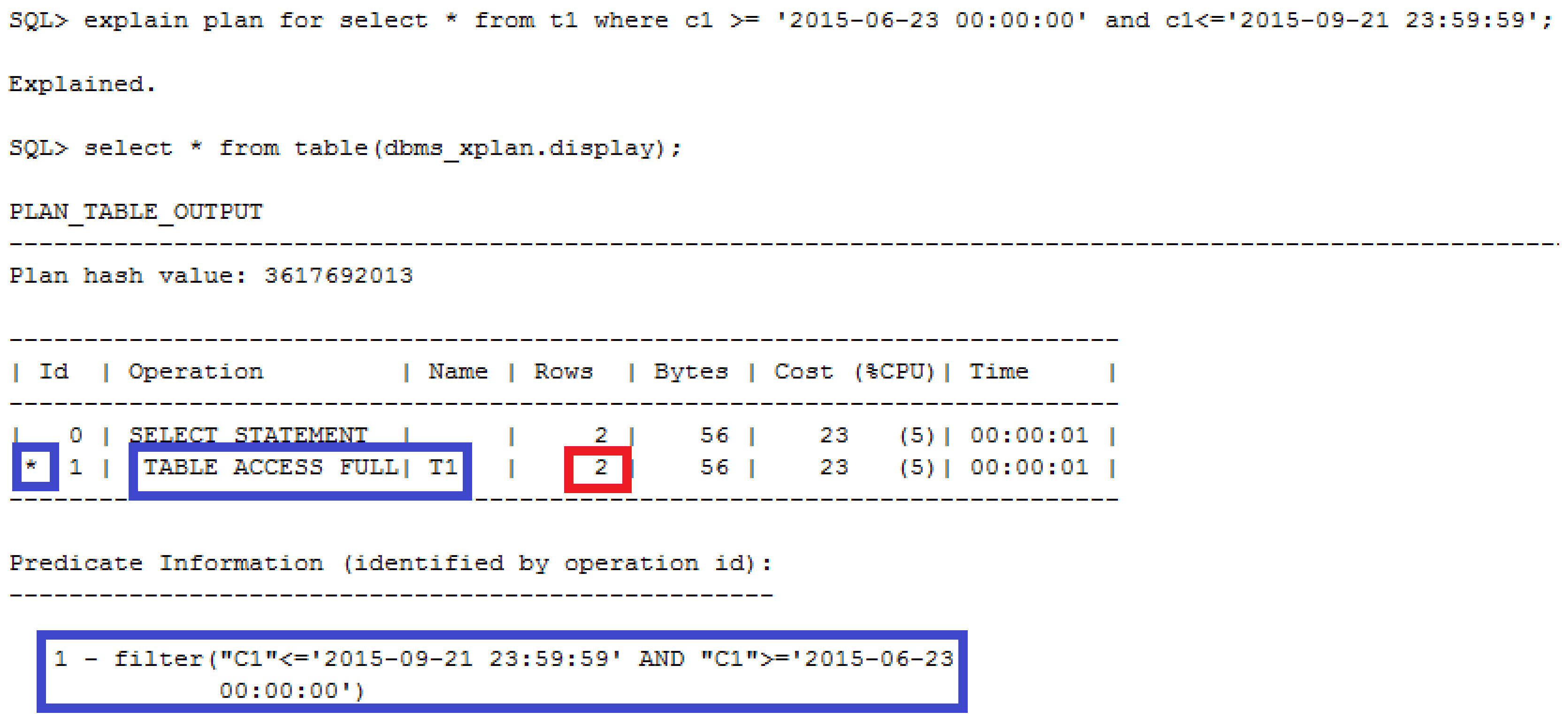


```
SQL> select min(c1),max(c1),min(d1),max(d1),count(*)  from t1;

MIN(C1)              MAX(C1)              MIN(D1)           MAX(D1)            COUNT(*)
-------------------- -------------------- ----------------- ----------------- ----------
2008-12-04 22:43:38  2025-05-09 15:31:38  20081204 22:43:38 20250509 15:31:38      20000
```



```
SQL> select count(*) from t1
       where c1 >= '2015-06-23 00:00:00'
        and c1<='2015-09-21 23:59:59';

  COUNT(*)
----------
       303
```

Varchar型c1的cardinality情况



```
SQL> explain plan for select * from t1 where c1 >= '2015-06-23 00:00:00' and c1<='2015-09-21 23:59:59';

Explained.

SQL> select * from table(dbms_xplan.display);

PLAN_TABLE_OUTPUT
--------------------------------------------------------------------------------
Plan hash value: 3617692013

--------------------------------------------------------------------------
| Id  | Operation         | Name | Rows  | Bytes | Cost (%CPU)| Time     |
--------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |      |     2 |    56 |    23   (5)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| T1   |     2 |    56 |    23   (5)| 00:00:01 |
--------------------------------------------------------------------------

Predicate Information (identified by operation id):
---------------------------------------------------

   1 - filter("C1"<='2015-09-21 23:59:59' AND "C1">='2015-06-23
              00:00:00')
```

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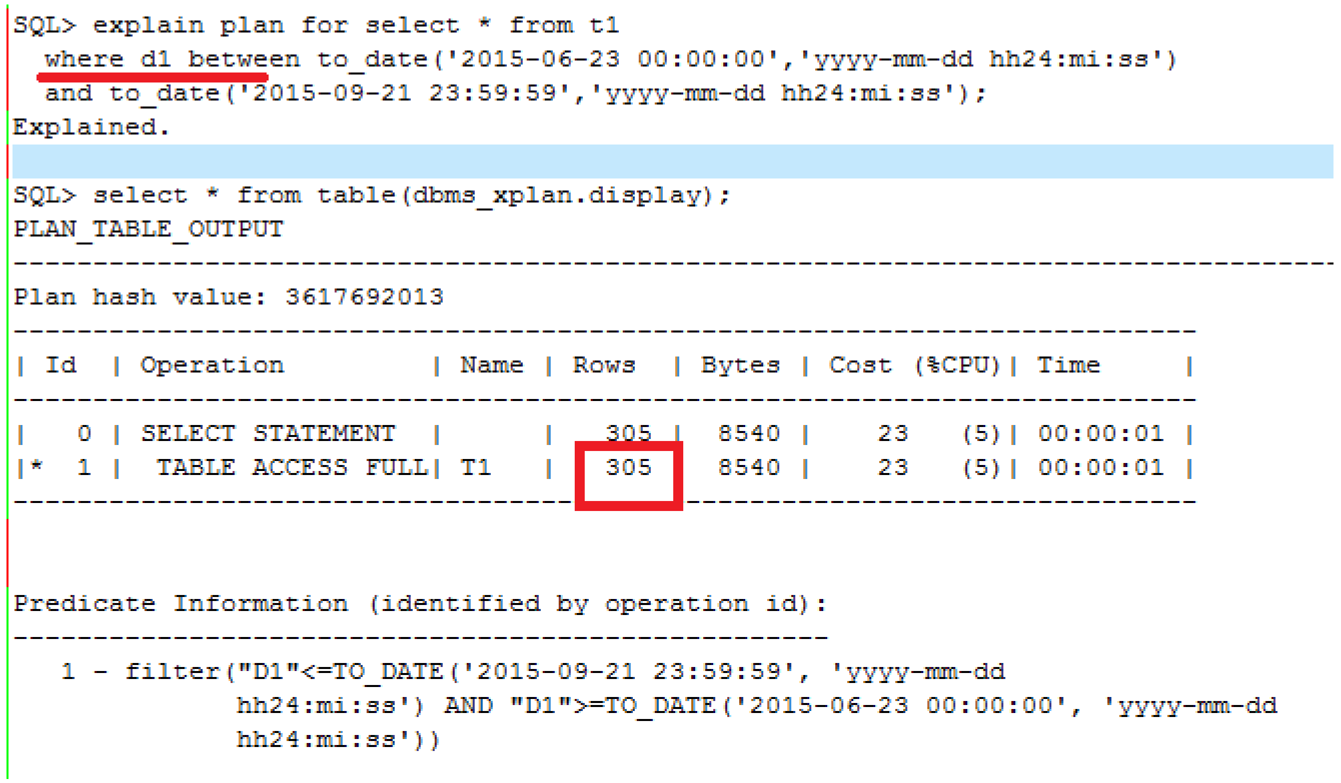
Date型D1列的cardinality估算情况



```
SQL> explain plan for select * from t1
  where d1 between to_date('2015-06-23 00:00:00','yyyy-mm-dd hh24:mi:ss')
  and to_date('2015-09-21 23:59:59','yyyy-mm-dd hh24:mi:ss');
Explained.

SQL> select * from table(dbms_xplan.display);
PLAN_TABLE_OUTPUT
-------------------------------------------------------------------------------------
Plan hash value: 3617692013
---------------------------------------------------------------------------
| Id  | Operation         | Name | Rows  | Bytes | Cost (%CPU)| Time     |
---------------------------------------------------------------------------
|   0 | SELECT STATEMENT  |      |   305 |  8540 |    23   (5)| 00:00:01 |
|*  1 |  TABLE ACCESS FULL| T1   |   305 |  8540 |    23   (5)| 00:00:01 |
---------------------------------------------------------------------------


Predicate Information (identified by operation id):
---------------------------------------------------
   1 - filter("D1"<=TO_DATE('2015-09-21 23:59:59', 'yyyy-mm-dd
              hh24:mi:ss') AND "D1">=TO_DATE('2015-06-23 00:00:00', 'yyyy-mm-dd
              hh24:mi:ss'))
```

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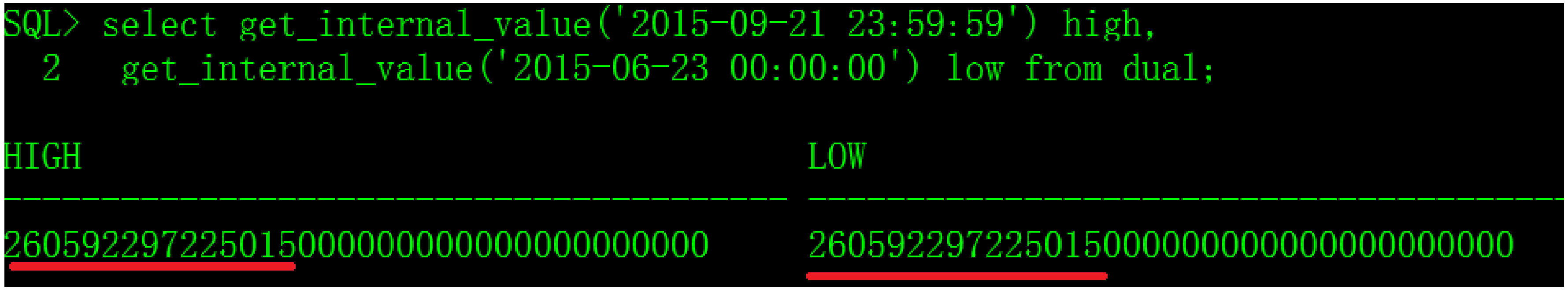
根因分析

- 假设SQL语句为 where col1 beteen :b1 and :b2

- 本质原因在于 where col1 beteen :b1 and :b2被当做了 where col1 = :b1,即选择率为1/num_distinct，于是返回行数被错误的低估了

- 选择率简单公式 selectity=（ :b2 - :b1 ）/ （ 列最大值－ 列的最小值 ）

续



```
SQL> select get_internal_value('2015-09-21 23:59:59') high,
  2   get_internal_value('2015-06-23 00:00:00') low from dual;

HIGH                                         LOW
-------------------------------------------- --------------------------------------------
260592297225015000000000000000000000          260592297225015000000000000000000000
```

CBO在计算字符串的>,<谓词的选择率时，如果不存在直方图，则需要把字符类型化成内部的数字类型，

然后按照selectity=(:b2 - :b1) / （ **列最大值 - 列的最小值** ）公式进行计算

我们可以看到,由于:b2和:b1对应的’ 2015-09-21 23:59:59’,’ 2015-06-23 00:00:00’这两个字符串的内部值是一样的，所以按照公式，分子为0，评估出来的就非常低，于是整个执行计划就错了！

结局方法、经验总结—由点带面

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收集直方图即可！
需要说明的是，如果判断数据不倾斜，则默认不收集直方图，那么对于刚上线额系统是致命的！

不要采用varchar来存储date型数据！
仅此而已？还有其他的么？当做作业吧

总结和预防

1、通过根因分析，避免了长时间停机和数据可能不一致的问题

2、如何预防？dataGuard /RAC ？

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THANK YOU

感谢您的关注

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